THE OPERATIONS OF SURGERY

THE

OPERATIONS OF SURGERY

(JACOBSON)

SIXTH EDITION

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With 797 Illustrations (40 in Colour)

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PART VI

OPERATIONS ON THE ABDOMEN

CHAPTER I

PREPARATION OF THE PATIENT FOR ABDOMINAL OPERATIONS

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PREPARATION OF THE PATIENT

EXCEPT in emergencies it is advantageous to admit the patient into the hospital or nursing home a day or two before an abdominal operation. Not only is the rest valuable for the patient, who also gets used to his attendants and surroundings generally, but he can be *systematically examined* with the double object of ascertaining if he is a fit subject to undergo the operation, and of making a more accurate diagnosis. For instance, X-ray examinations of the stomach and intestine after bismuth oxychloride has been given often reveal new and valuable facts.

The *preparations* already described in vol. i (ch. i.) can be carefully carried out. After a hot bath the abdomen is generally shaved, rubbed with ether or acetone, painted with tincture of iodine, and covered with a sterile pad. This is done in the ward. On the table the abdomen is again painted with iodine. For all abdominal operations it is important to pay special attention to the *diet and to get the bowels thoroughly emptied,* for in this way the virulence of the intestinal contents is lowered and the comfort of the patient during the first few days after the operation is greatly increased. In nearly all cases a brisk aperient like calomel gr. 5, or castor oil 1 oz., is given about thirty-six hours before the operation, and this is followed by a saline aperient early next morning and if necessary by a soap enema. In some cases the enema is repeated on the evening before the operation. The patient should keep in bed on the day before the operation, and should take only light and sterilised food. This consists almost entirely of liquid such as milk, soup, and beef-tea. In some cases, especially of gastric dilatation, it is an advantage to give only solid sterilised food, such as eggs, jelly, and salad oil, by the mouth, and all necessary liquid in the form of saline enemata night and morning. In some cases it is an advantage to have the patient admitted three or four days before the operation. This is particularly so in cases of extreme pyloric obstruction requiring gastric lavage and saline enemata, cases of chronic intestinal obstruction requiring repeated doses of aperients, and obscure urinary cases requiring careful investigation. It is also valuable when the mouth is septic and there are carious teeth or pyorrhœa alveolaris. The teeth may require scaling, some of them may have to be removed and others temporarily stopped. In any case a clean tooth-

brush and mouth-wash should be used frequently during the day. These precautions are valuable in preventing pneumonia and parotiditis after the operation.

THE CHOICE OF ABDOMINAL INCISION

The ultimate result of an abdominal operation depends a good deal on the wise choice of the most suitable incision.

The Site of the incision should be carefully chosen with a view of giving the best approach with the minimum amount of damage. For instance, when the appendix is known to be unusually high and retro-colic the ordinary McBurney incision does not give good access, whereas a similar incision made somewhat higher and further back towards the loin is very satisfactory. In the same way, when the appendix is believed
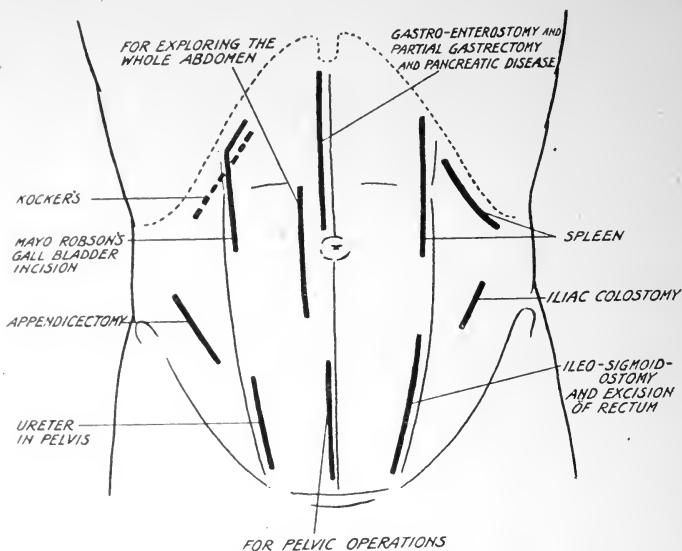
FIG. 1. Abdominal incisions.

to be in the pelvis the incision is made lower down and nearer the middle line with great advantage. In many cases a laparotomy must commence with a general exploration of the abdomen, for in this way only can the cause of symptoms be thoroughly investigated. Under these circumstances the best place for the incision is near the middle line with its centre at the level of the umbilicus. Through an incision about five inches long in this position the whole abdomen can be thoroughly explored, and if necessary for treatment the incision can be enlarged either upwards or downwards without making an unnecessarily large wound.

The Size of the incision should be adequate without being excessive, for very large incisions undoubtedly weaken the abdominal wall; but it is a more common and worse mistake to make the incision too small. An inadequate incision makes the operation much more difficult and often leads to imperfect exploration, bruising, and laceration of the edges with unsatisfactory closing and healing of the wound. Moreover it is more difficult to cover and protect the edges of the wound from infection by

septic abdominal contents which may be liberated during the operation. To improve the view, and especially to ease the sewing of the deep layers of the wound, it is essential to make the incision in the skin longer than the one in the aponeurosis. The incision in the transversalis fascia and peritoneum is still smaller. Fortunately the length of the skin incision on the abdomen is immaterial, and in very stout people it is an advantage to make the skin incision unusually long so that the fatty layers may fall aside, thus giving a much better access to the deeper parts. As far as possible the muscular fibres of the abdominal wall are not cut across,
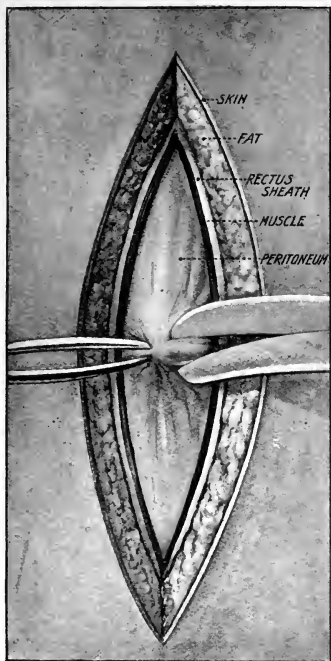
Fig. 2. Dividing the peritoneum, which is held up with toothed forceps.

Fig. 3. Enlarging the peritoneal wound, the fingers protecting the viscera.

but merely separated or drawn aside. This is a valuable safeguard against ventral hernia, especially in the lower part of the abdomen. In the upper part the division of muscular fibres is not so detrimental ; for instance, the Kocher incision for gall-bladder surgery, although it divides the fibres of the rectus muscle, is very rarely followed by ventral hernia. Similarly the usual oblique incision in the loin for exposing the kidney is very rarely followed by hernia, and as it also gives a much better view most operators prefer it to any form of muscular separation. For the same reason no nerve fibres are to be unnecessarily cut across. A long vertical incision through the outer part of the rectus may lead to paralysis of this muscle by division of its nerves, and a troublesome form of ventral hernia follows. This is particularly liable to happen when the incision extends low down. Similarly injury to the nerves lying between the flat muscles during the ordinary operation for appendicitis may lead to

paralysis of the lower fibres of these muscles, with the result that either a ventral or a right inguinal hernia may develop.

As far as possible the division or injury of the deep epigastric vein is also to be avoided, especially when dealing with peritonitis or abscess, for septic thrombosis of this vessel may then follow and extend to the iliac veins, with disastrous results in the way of thrombosis or embolism.

The wound is made by a clean cut with a knife until the aponeurosis has been divided. Then the muscular fibres are displaced and held aside by smooth retractors. All bleeding is arrested with artery forceps and
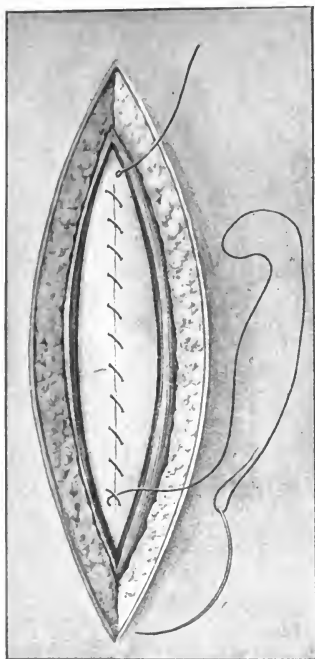
Fig. 4. The peritoneal suture of catgut has been commenced at the upper end of the wound.
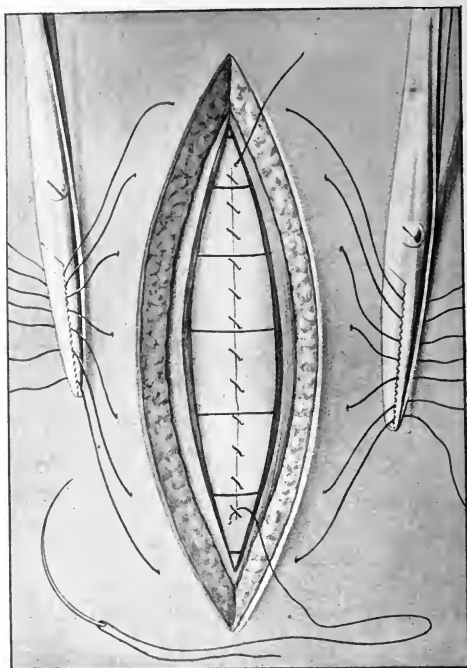
Fig. 5. Interrupted salmon-gut sutures have been inserted. Their ends are clamped while the catgut suture is continued up the anterior wall of the rectus sheath.

catgut ligatures. Then the transversalis fascia and peritoneum are picked up with toothed dissecting forceps and carefully divided either with blunt-pointed scissors or with a knife held sideways. First one and then two fingers are introduced to protect the bowel while the wound is enlarged with blunt-pointed scissors.

In many cases it is important to protect the edges of the wound from infection during the operation, and this can be done by accurately securing sterile pads round the edges with suitable forceps and self-retaining retractors directly the abdomen is opened.

Closing the Wound Accurately. This is of great importance in order to prevent ventral hernia. While both ends of the peritoneal incision are held well up by an assistant with long toothed artery forceps, medium-sized catgut threaded on a curved round needle is used as a

continuous suture to sew the peritoneum and deep layer of the rectus sheath, starting at the upper end of the incision. This is easier than working in the opposite direction. When the lower end is reached the needle is passed under the last turn of suture, which is then drawn tight. This prevents gaping of the lower end of the peritoneal wound with prolapse of the omentum during the next stage. Stout fishing-gut sutures are passed through the skin, subcutaneous tissues, rectus sheath, and some of the fibres of the rectus. The ends of these sutures, which are
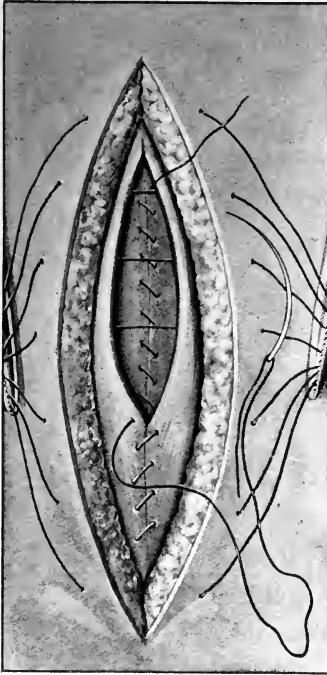
FIG. 6.   The peritoneal catgut suture is continued up the rectus sheath.
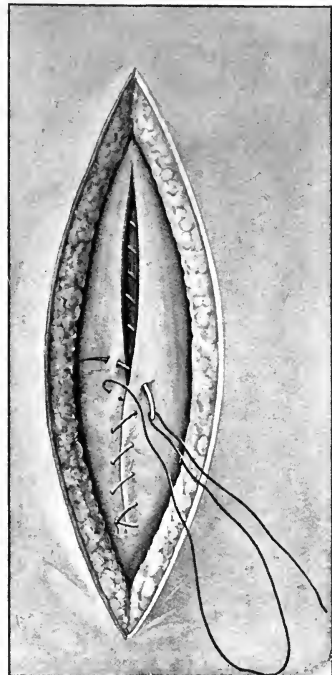
FIG. 7.   The overlapping method of closing the rectus sheath.

about three-quarters of an inch apart, are clamped together on each side of the wound and thus kept out of the way, while the continuous catgut suture already mentioned is used to close the anterior wall of the rectus sheath from below up. It is tied to the end left long at the upper end of the peritoneal wound. The edges of the skin are brought accurately together with fine catgut. The supporting sutures of salmon-gut are then tied. These are important, for the catgut is not sufficient by itself, but may break when submitted to excessive strain during coughing or vomiting. This may lead either to a ventral hernia or even to the early prolapse of a loop of bowel into the deeper part of the wound, where it may become obstructed or strangulated. To prevent this catastrophe silk or linen thread has been used for the buried suture, but occasionally a stitch sinus follows. For this reason it is very much better to use strong catgut with supporting salmon-gut sutures to be left in about ten
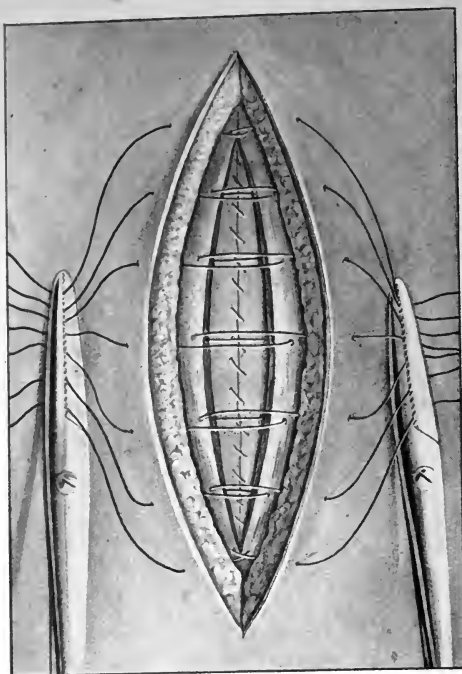
Fig. 8.   Another and quick method of closing the abdomen in grave cases.
See also Fig. 9.
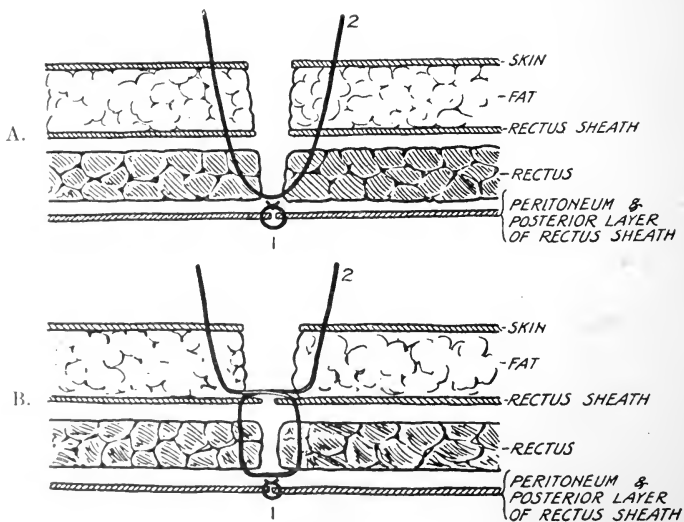
Fig. 9.   A. and B.   Sections showing methods of closing the abdominal wound.
Suture 2 is strong fishing-gut.   In B the figure-of-eight suture secures very
good apposition.

days. In some cases when the abdominal wall is lax and there is thought to be a risk of ventral hernia it is an advantage to overlap the aponeurosis after Noble's method.

When drainage has to be adopted a slit rubber tube of half to one inch internal diameter and containing a wick of gauze is used. The gauze can be changed from day to day, and the tube removed after several days without hurting the patient. A tube is far more efficient and less painful than gauze, which adheres to the edges of the wound, and often acts as a plug instead of a drain. If gauze is used it should be left for five or six days, when it gets loose and can be removed without much pain or hæmorrhage. The remainder of the wound is closed in layers in the usual way.

AFTER-TREATMENT

Much of the increasing success of abdominal operations depends upon careful after-treatment. It is a common mistake to interfere too much, for it is sometimes difficult to know when to leave well alone ; but on the other hand treatment for some of the complications to be mentioned below has to be prompt to save life. Usually there is very little to be done beyond careful nursing, attention to the diet, and general comfort of the patient. The difficulty lies in knowing quickly when things are going wrong. As far as possible complications should be prevented by care and untiring attention to detail before, during, and after operation.

Fig. 10. The oblique or sitting-up position. The headpiece moves to any angle as it slips up and down the pillars at the head of the bed. The position is easily altered with the straps and buckles attached to the bolster under the thighs.

(1) **Posture.** When returned to bed the patient has only one small pillow under his head and is rolled slightly to one side, with another pillow behind the shoulders. This lessens the risk of the aspiration of vomit and enables the patient to breathe more freely, as the tongue does not fall back. The nurse never leaves him until he has regained consciousness.

About two hours after the operation the patient is usually placed in the oblique position with his shoulders well raised by pillows or some mechanical contrivance. In this position he is much more comfortable and breathes more easily; pulmonary complications are less likely, and after gastro-enterostomy the contents of the stomach drain away more freely into the intestine. After operations for appendicitis with suppuration the sitting-up or Fowler position tends to limit the infection to the pelvis; it also facilitates drainage soon after operations for general peritonitis. For some operations upon the biliary apparatus it is, however, an advantage for the patient to keep nearly flat for about twelve hours until limiting adhesions have formed to prevent leakage of bile into the peritoneal cavity.

From the first the patient is encouraged to move his feet and legs in order to prevent wasting. In some cases massage of the limbs is very useful for the same reason. Free use of the limbs and a change of position by the nurse at first and later by the patient also tend to prevent thrombosis with pulmonary embolism. Change of position and active movements are valuable also in preventing pulmonary complications. For the same reason it is not good for the patient to be kept in bed too long. In most cases the patient can be lifted on to a couch at the end of four or five days and begin to walk at the end of a week or ten days. I believe that stagnation in bed is one common cause of thrombosis, pulmonary embolism, and pulmonary complications generally. After many operations the patient can safely leave the hospital or nursing home for a convalescent home at the end of a fortnight, but it is rarely wise for him to return to work under three or four weeks from the date of the operation. A too early return leads to an incomplete recovery of general health.

(2) **Shock.** To lessen shock the head is depressed, the abdomen is firmly supported by a many-tailed bandage, and sometimes by a large towel in addition, and the patient is kept warm with blankets and hot-water bottles. In many cases an infusion of about one pint of warm normal saline solution (temp. 105° F.) or an isotonic solution of dextrose is given into the middle of each axilla immediately after the patient is returned to bed; and an ampoule of pituitary extract is injected either intramuscularly or directly into a vein. In a few cases of great urgency, when the circulation is too poor to absorb the saline solution from the armpit, it is given directly into a vein, usually the median basilic. No more than three pints are to be given at a time for fear of causing œdema of the lungs. It is better to repeat the injection after two hours if necessary. In most cases it is sufficient to give a saline enema of one pint containing 20 to 30 grains of aspirin very slowly. The aspirin eases pain. Half a pint of saline is administered by the rectum every three or four hours until vomiting has ceased and
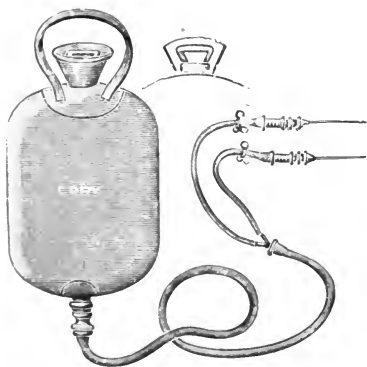

FIG. 11. *Infusion Apparatus.* The whole can be boiled and is very convenient to carry. The rubber bag holds three pints. The rubber tube is long and the needles of good size. They are generally passed through the pectoralis major into the middle of the axilla. A flannel cover for the bag is useful to keep the solution warm.

the patient is taking enough liquid by the mouth. In other cases warm saline solution is continuously and slowly administered by the rectum. The rectal tube should have several apertures, and should not be too long or have too small a lumen. Otherwise flatus cannot escape, with the result that the saline is not retained. This is especially valuable in cases of peritonitis, when as many as five or six pints are often given in twelve hours. There is no advantage in giving more. In most cases the enemata are not required after twenty-four or thirty-six hours. They lessen thirst, shock, and vomiting.

(3) **Thirst.** This is also alleviated by making the patient wash out the mouth with water or a weak solution of bicarbonate of soda, and especially by the frequent cleansing of the mouth by the nurse with lemon-juice and glycerine or glycerine and borax. When nausea has ceased water is given in increasing quantities by the mouth. The teeth are thoroughly cleaned at least twice a day with a clean tooth-brush and an antiseptic solution such as Listerine. The tongue is also thoroughly cleaned with lint moistened with glycerine and borax. These precautions, besides adding to the patient's comfort, greatly diminish the risk of pulmonary complications from the aspiration of septic material into the lungs. They also make ascending septic infection of the parotid gland very rare at the present day.

(4) **Vomiting.** For various reasons vomiting after operations is not nearly so common or severe as it used to be a few years ago. More perfect asepsis; the better administration of anæsthetics, especially the almost universal adoption of open ether following morphia, and atropine or scopolamine, which lessen the amount of anæsthetic used; and the more common use of saline infusion in one way or another, all lessen the severity of vomiting. Keeping the patient's head low and turned to one side during the administration of the anæsthetic in order to prevent swallowing of mucus saturated with the anæsthetic also helps to prevent vomiting from the direct irritation of the stomach by the anæsthetic. It is often a good plan to let the patient take a good drink of warm solution of bicarbonate of soda to wash out the stomach. Repeated doses of about 30 grains of sodium bicarbonate are also valuable, for the vomiting is often due to acidosis. Chloretone 5 grains often acts like a charm. When the vomiting continues after twenty-four hours other causes than the anæsthetic must be considered. In many cases it is due to partial paralysis and over-distension of the stomach. In any case lavage should be tried, the stomach being thoroughly washed out with a weak solution of bicarbonate of soda. If this does not stop the vomiting there is usually a more serious cause, such as peritonitis or intestinal obstruction. In these conditions the contents of the intestine regurgitate into the stomach and vomiting continues. Occasionally it continues for several days after the operation, apparently without any adequate cause. These patients are mostly very nervous women. In addition to washing out the stomach warm applications or even a blister may be applied to the epigastrium, and a dose of potassium bromide 25 grains, and chloral hydrate 25 grains, may be given by the rectum. In some cases the vomiting may be due to acute dilatation of the stomach, and the possibility of this is always to be remembered. At first there is bulging of the epigastrium, and later on the whole abdomen becomes enormously distended. Small quantities are brought up at frequent intervals. The stomach tube should be passed at once and the stomach thoroughly emptied and washed out, and the

position of the patient should be changed as suggested by Moynihan, who recommends the prone position with elevation of the pelvis. This complication is fortunately a very rare one and can, I believe, be prevented by resorting to lavage early enough.

(5) **Food.** When nausea has ceased water is given by the mouth, at first in small quantities, but if it does not cause vomiting it is rapidly increased. After twelve to twenty-four hours equal parts of milk and water or barley-water are given in small feeds, such as one to two ounces every hour. In many cases weak tea is also given early and is often liked and retained when milk is not. After twenty-four hours milk thickened and flavoured in different ways, soup or beef-tea, and jelly are given ; also lemonade or orange or grape juice. On the third day thin bread and butter, milk puddings, and lightly boiled eggs are given, and on the fourth or fifth day more solid food in the form of fish, sweetbread, or chicken is given. All milk and food given in the early days after the operation should be sterilised. Occasionally vomiting and diarrhœa prevent the absorption of anything administered by the mouth or rectum. Saline infusions into the axillæ or thighs, given slowly and continuously or intermittently, usually suffice. In some cases sterilised olive oil or normal horse serum is given subcutaneously.

(6) **Pain.** For the relief of pain, aspirin, 10 grains by the mouth or 20 to 30 grains by the rectum, usually suffices. In some cases, however, when the pain is severe or the patient feeble and exhausted from want of sleep, a small dose such as $\frac{1}{6}$ or $\frac{1}{4}$ grain of morphine may be given in the evening. It is rarely wise to repeat the dose, for morphine paralyses unstriped muscle, increases flatulence, and tends to produce paralytic distension of the bowel.

(7) **Urine.** As a rule very little urine is secreted during the first twelve hours after an abdominal operation. The patient should be encouraged to empty the bladder at the end of twelve hours, and regularly every four hours after this. In this way paralytic distension of the bladder can be avoided. If there is any difficulty it is an advantage to turn the patient on his side and to apply hot fomentations or give an enema. If there has been no relief within twenty-four hours a boiled soft rubber catheter is passed with due aseptic precautions. Afterwards the patient should be encouraged to empty the bladder every four hours in order to avoid a repetition of the trouble. If necessary the catheter is passed every eight hours until the power of the bladder has returned. In some cases retention of urine is overlooked because the patient passes water in small quantities at short intervals. This means paralytic distension with overflow, and when a catheter is passed a large amount of urine may be found in the bladder. This condition may not develop until several days after the operation. For this reason it is of great importance to measure the urine for the first few days. The patient generally passes about one pint in the first twenty-four hours and afterwards should pass at least two pints every twenty-four hours.

(8) **Flatulence.** If there is much flatulence, this, when chiefly gastric, is often relieved by propping the patient well up and by occasionally giving a drop of peppermint oil on a small piece of bread by the mouth and immediately washing it down with water. Intestinal flatulence is often relieved by passing a rectal tube into the lower part of the rectum and leaving it there for some time. In extreme cases a turpentine enema (oil of turpentine 1 oz., mucilage of starch 15 oz.) is used and

rarely fails to afford relief. Pituitary extract given subcutaneously often acts like a charm.

(9) **Purgatives.** Usually the rectum is washed out with a pint of soap and water every morning. It is rarely necessary or wise to give any aperient by the mouth until the evening of the third day, when pil. col. et hyos., gr. 4 to gr. 8, may be given, followed by a saline draught in the morning, and if necessary by an enema. In some cases 1 oz. of castor oil is given early in the morning, and followed by saline and an enema if necessary. This has the advantage of allowing the patient a comfortable night. Afterwards some mild aperient, such as cascara sagrada, infusion of senna pods, or liquid paraffin, is given if required. In many cases, especially acute abdominal conditions such as appendicitis with suppuration, or where peritonitis from whatever cause is feared, it is better not to give any aperient by the mouth within the first four days. It is not wise to increase peristalsis in these cases, for movements of the bowel tend to disseminate infective material. Generally the bowels act spontaneously on the third or fourth day, especially when the lower bowel is kept empty by the daily wash-out. The bowels are generally almost empty at the time of the operation and there is no advantage to be derived from giving purgatives in the first few days. In cases of peritonitis not only are purgatives often ineffective, but they also add greatly to the patient's discomfort, act as irritant poisons, and tend to increase paralytic distension. It is only an ancient superstition that recovery from peritonitis depends on free purgation. Calomel, even in small doses given repeatedly, is especially dangerous when it fails to act.

(10) **Dressing the Wound.** When the wound has been completely closed it is rarely necessary to disturb it for about ten days, although a tight bandage may need to be readjusted and excess of dressings may need removing. When the wound has been drained by a split tube with a wick of gauze the tube is not disturbed for at least four days, although the wick may be changed daily if necessary. There is no advantage in removing the tube too soon, for a re-collection may occur in the deeper parts of the wound. There is no need to remove the tube for boiling or cleansing. It is sufficient to wash the wound with peroxide of hydrogen or other weak antiseptic solution. Syringing is unnecessary, painful, and dangerous.

Complications. Most of these have already been mentioned, but it is well to consider some of them more fully.

(a) *Hæmatemesis.* This sometimes follows gastric operations when the sewing is at fault. Apart from this the vomit may be black from altered blood. This is a very grave sign and usually indicates an acute septicæmia with oozing of blood from the mucous membrane of the stomach and upper intestines. It also sometimes follows the use of purgatives which are retained in the bowel and act as powerful irritants. It is especially liable to follow calomel given in small doses repeatedly. Most of the patients who develop this symptom die. The best thing to do is to wash out the stomach repeatedly if the condition of the patient allows this. In some cases small doses of adrenalin chloride may be given by the mouth, and saline infusions into the axillæ or rectum are also given.

(b) *Peritonitis.* That this is a very rare complication at the present day is chiefly due to the careful precautions taken during operations to prevent leakage or contamination. We owe much to the careful and

routine use of clamps and packs. The adoption of continuous sutures instead of mechanical devices such as Murphy's button for making anastomosis is also a great safeguard against sloughing and secondary leakage, which used to be more common. The universal adoption of rubber gloves has done a great deal to exclude extraneous infection. Occasionally, however, peritonitis does develop after an anastomosis of the lower part of the small intestine for intestinal obstruction. It is of very great importance to recognise the condition, for it is well known that a secondary peritonitis is easily overlooked and has a very high mortality. It is rarely worth while to open the abdomen when the disease is well advanced, but if the condition is recognised quite early reopening the abdomen and adequate treatment of the cause with free drainage of the peritoneum are always worth doing. The early signs of peritonitis are therefore of great importance. These are pain and restlessness, with an increasing pulse-rate from 110 to 140. The pulse always becomes weak and the patient soon cold and clammy with an anxious expression. The knees are drawn up, sometimes there is vomiting or hiccough, sometimes the temperature goes up, but above all the abdomen becomes tender, fixed, and rigid. These signs are especially ominous when they present themselves in the flank, where they cannot be mistaken for the natural tenderness around the wound.

(c) *Intestinal obstruction* sometimes follows abdominal operations, but is not always due to them. It is especially likely to happen from kinking after incomplete operations for suppurative appendicitis. Occasionally a kink occurs above an anastomosis, and bands or accidental hernia either into the deeper parts of the wound or into the omentum or mesentery may occur. It is of vital importance to recognise the condition while it is still hopeful. The most important signs are persistent vomiting in spite of lavage, the vomit gradually becoming bilious and later brown and foul. Meanwhile the pulse is slow and the patient in much pain and collapsed. The bowels fail to act in spite of repeated enemata. The secretion of urine is almost abolished and abdominal distension increases, with visible peristalsis in some cases. When the condition is strongly suspected the abdomen should be opened without delay and the condition dealt with as may seem fit.

(d) *Pulmonary complications.* Attention has already been drawn to the great importance of keeping the mouth clean and of the sitting-up position. Care should also be taken to prevent infection from the anæsthetic apparatus or from the aspiration of vomit during or after the anæsthetic. For this reason it is of the greatest importance to wash out the stomach before the operation in many cases of intestinal obstruction and also of gastric dilatation. The abdominal bandage should not be tight enough or extend high enough to restrict breathing, and the patient should be encouraged from the beginning to take deep breaths several times daily. Compression of the bases of the lungs should also be avoided during the operation. For this reason the Trendelenburg position, when required, should not be maintained longer than necessary. When intravenous infusion of large quantities of saline solution was common pulmonary complications were sometimes secondary to œdema of the lungs, and that is one of the reasons why axillary infusion and especially rectal salines are much better than intravenous infusion in the great majority of cases, for the blood-pressure is never raised so much or so suddenly by them as it is by intravenous infusion.

The anæsthetic, especially ether, has been held responsible for pulmonary complications following operations, and there is no doubt that the chilling effect of ether on the lungs of old people, especially those already subject to chronic bronchitis, is detrimental, and for them either equal parts of chloroform and ether or chloroform is to be preferred. It is very important to avoid undue exposure of the patient before, during, and after operation. He should be warmly clothed and shielded from draughts, especially when collapsed after the operation. With the same object in view the theatre should not be too hot, so that the contrast may not be too great. Too frequently the patient, drenched with perspiration in a hot theatre, is carried to a comparatively cold ward. I firmly believe that it is rarely advantageous to have the temperature of the theatre above 65°, for not only does the free perspiration commonly seen predispose to chills, but it also increases shock by depletion.

The most common pulmonary complications are pneumonia, especially of the lobular type, bronchitis, pleurisy, and empyema. They are particularly apt to follow operations in the upper abdomen which more commonly limit the movements of the diaphragm. They are undoubtedly due to septic embolism in a great many cases, and this is an additional reason for providing efficient drainage in septic cases and for removing a diseased appendix and its blood-vessels in cases of suppurating appendicitis.

A post-operative empyema is particularly likely to be overlooked; an exploring needle should be inserted when there is reasonable suspicion of its existence.

Thrombosis and Embolism are mostly due to stasis and sepsis of the blood. Too complete rest in bed lowers the force and frequency of the heart-beat, retards the circulation, and predisposes to clotting. For this reason the patient should be turned and moved *about fairly freely from the beginning* and should be encouraged to move his limbs freely. For the same reason it is important to get the patient out of bed after an operation as soon as possible. It is also an advantage in many cases, especially when the pulse is weak and slow, to give small doses of strychnine. It is said that a too exclusive milk diet predisposes to clotting on account of the large amount of lime salt. There is no doubt, however, that the clot contains bacteria, often of low virulence, in nearly all cases, so that phlebitis frequently precedes or accompanies thrombosis. For this reason it is of great importance to aim at perfect asepsis throughout abdominal operations and also to avoid injury to veins, especially in dealing with septic conditions. For the same reason it is important to open abscesses early and to drain them thoroughly without allowing the tube to press upon the veins. It is especially noteworthy that thrombosis is particularly liable to follow pelvic operations, especially hysterectomy. In these cases it is probable that a mild septic inflammation short of suppuration prevails in the tissues of the pelvis and causes inflammation of the iliac veins. As is well known the left leg is the one most commonly affected. For various reasons the venous return from this leg is poorer than from the right. When signs of thrombosis develop it is important to keep the patient at rest for at least three weeks so as to avoid as far as possible the risk of embolism.

Pulmonary Embolism as a rule is an unforeseen catastrophe, for in the majority of cases there has been no indication of a previous thrombosis, although organised clot taken from the pulmonary artery and floated

in water sometimes shows by its shape that it has previously occupied a large vein and its tributaries.   Usually this is the internal iliac vein, an examination of which after death may show adherent clot or signs of phlebitis.   In other cases the clot is formed in the right auricular appendix. In most cases the embolus is not large enough to completely block the pulmonary artery so as to cause sudden death, but spreading thrombosis may gradually complete the obstruction.   In many cases smaller emboli block some of the larger or smaller branches of the pulmonary artery. Infarction follows and is indicated by pain, dulness, a rub, and hæmoptysis.   In grave cases nothing does any good but the administration of oxygen, and strychnine should always be tried and may tide the patient over his difficulties in some cases of incomplete obstruction.   In a few the embolus has been removed from the pulmonary artery, but not as yet with any permanent success.   The best-known way to prevent pulmonary embolism is to adopt the precautions against thrombosis which have been already mentioned.

CHAPTER II

OPERATIONS ON HERNIA [1]

OPERATIONS FOR STRANGULATED HERNIA. RADICAL CURE OF HERNIA

OPERATIONS FOR STRANGULATED HERNIA

It is very important to operate early and not to waste valuable time on taxis. Thus Carwardine [2] from an analysis of 183 cases found the mortality to be less than 2 per cent. in those operated upon within twelve hours, more than 10 per cent. when twelve to twenty-four hours had elapsed before operation, and that after five days had been wasted 60 per cent. died.

Chief Indications for Operation and Points to bear in mind. While this is not the place for going into the above fully, a few practical remarks on those indications usually given may be helpful to some of my readers.

A. *Local.* A lump in one of the openings, more or less hard, tense, and tender, dull, partly or completely irreducible, and with impulse doubtful or absent.

(*a*) The swelling may be small and deep-seated, as in a bubonocele near the internal ring, or a femoral hernia in a fat patient.

(*b*) Two herniæ may be present, both irreducible. The surgeon should operate on the one which is the more tense and has the less impulse, and the one which has the more recently descended. If this fail to reveal the obstruction, either the opposite swelling must be explored or abdominal section performed in the middle line. This step will probably allow of the opposite hernia being reduced from within, and also of any other possible seats of strangulation being explored, viz. the inner aspects of the deeper rings.

(*c*) As to the impulse, it is worth while to observe carefully the point where this ceases. This probably is over the site of stricture, and should be about the centre of the incision.

On this most important point of impulse Sir W. H. Bennett speaks as follows : In a case of strangulated omental inguinal hernia with commencing gangrene of the omentum, there yet was no interference with the action of the bowels, constipation and vomiting were alike entirely absent, but the symptom which conclusively called for operation was the entire absence of real hernial impulse. The following remarks

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[1] The different forms of hernia, those which present on the thigh as well as the inguinal and umbilical varieties, will be considered here for the sake of convenience and because they are all abdominal in origin.

[2] *Brit. Med. Journ.*, 1901, vol. ii, p. 573.

on the detection of impulse are worthy of the most careful attention :
" The impulse in ordinary non-strangulated hernia, whether the contents
of the sac be omentum or bowel, is *expansile* in character—that is to
say, the tumour, when the patient coughs or strains, not only rises
under the hand, but expands in size. In hernial tumours containing
bowel this sudden increase in the bulk is principally due to the additional
quantity of gas, &c., which is suddenly driven into the herniated portion
of gut by the act of coughing or straining. In omental herniæ the
expansion is partly due to the sudden turgescence in the omental vessels,
and partly to the increase of tension in the sac due to the cough.
Naturally, therefore, the amount of expansion is relatively greater in
herniæ containing bowel than in those composed of omentum. . . . In
strangulated hernia it is important to understand that absence of impulse
does not necessarily mean *immobility* during coughing, for a hernia,
even if tightly strangulated, will often move freely under the hand,
especially if it be omental. This movement is, however, rather of the
nature of a jump or jerk, and is never expansile. There is no question
which has a more practical bearing upon the treatment of strangulated
hernia than the expansile character of this impulse. It may be safely
held as a surgical dictum, that *every case of hernia in which any change has
taken place in the condition of the tumour, such as increase of size or tension,
whilst expansile impulse is absent, should be regarded as strangulated.*"

(*d*) Sir J. Paget[1] thus wrote of the *hardness* of a hernia : " In large
herniæ the hardness may chiefly be felt at and near the neck and mouth
of the sac, especially in inguinal herniæ, and you must take care not
to be deceived by a sac which is soft and flaccid everywhere except at
its mouth, for there may be strangulated intestine in the mouth of the
sac, though the rest contain only soft omentum or fluid not sufficient to
distend it ; nay, you must not let even a wholly soft condition of the
hernia, or an open external ring, weigh down against the well-marked
symptoms of strangulation, for the piece of intestine at the mouth of
the sac may be too small to give a sensation of hardness, or the whole
hernia may be omental."

B. *General : The Symptoms of Intestinal Obstruction.* (1) Consti-
pation becoming absolute, even as to flatus. It is well known that
small scybalous motions may be forced out by the straining of a patient
with a strangulated hernia anxious to get his bowels to act. Further,
and in intestinal obstruction generally, the bubbling away of an enema
may simulate the passage of flatus. In those rare cases where, other
evidence of strangulation being present, the bowels continue to act
at intervals, it is probable that the constriction of the bowel is not com-
plete, but leaves a channel along the mesenteric border (Richter's partial
enterocele). In such cases which have been left long, owing to the
absence of constipation and perhaps the slightness of the vomiting, the
surgeon must examine the bowel very carefully before he returns it.
Constriction, though only partial, may have caused here, from its long
duration, thinning or ulceration of the intestine at one spot, and fæcal
extravasation may take place as soon as the bowel is returned. If there
is any reason for doubt in these cases the stricture should be thoroughly
divided and the bowel left *in situ*.

Constipation may be absent in cases of strangulation of the omentum
alone, or of an appendix epiploica, or of the ovary.

[1] *Clin. Lect.*, p. 108.

(2) Vomiting.[1] Especially if (a) this is changing from the early rejection of stomach contents or bile to fæculent fluid; (b) even if it is repeated only at long intervals, and all other signs are absent or little marked; (c) it must be remembered that vomiting may be stopped by drugs, strangulation persisting, or the intestines may be empty. There is often a deceptive lull in this symptom after two or three days, the vomiting recommencing again later.

(3) Shock more or less severe, according to the suddenness of the onset and the severity of the strangulation.

(4) Colicky pains occurring at short intervals, usually terminating in vomiting. These pains are usually referred to the umbilical region, and are due to the powerful but futile peristalsis of the obstructed small intestine. They are very characteristic of intestinal obstruction. Coils of small intestine with visible peristalsis may be noticed.

(5) The sunken, sallow features and anxious countenance, and the scanty high-coloured urine from intestinal obstruction.

(6) Tympanites and abdominal tenderness.

These will not, of course, debar the surgeon from operating, but they will lead him to warn the friends that relief will possibly come too late.

STRANGULATED FEMORAL HERNIA

The stomach may be washed out in some cases just before the operation to minimise the dangers incident to the vomiting of foul material during the operation and afterwards.

In bad cases a hypodermic injection of pituitary extract may be given just before or during the operation. Subcutaneous or axillary infusion of a pint or more of saline is also of great benefit, and can be performed while preparations are being made for the operation. In less severe cases a rectal injection of a pint of saline solution may be slowly given.

Operation.[2] The parts being shaved and thoroughly cleansed, the limbs being kept warm with blankets and a hot bottle or two if the patient's vitality is low, and the knee flexed slightly over a pillow, an incision two and a half to three inches long is made obliquely over the swelling, its outer end being an inch above the middle of Poupart's ligament and the inner extending over the inner and lower end of the hernial sac. Poupart's ligament and the lower fibres of the external oblique are defined. The cribriform fascia and the fascia propria (femoral sheath and septum crurale) are next divided in the same line, with or without a director,[3] according to their thickness and the experience of the operator, all the incisions made going quite up to and above the top of the swelling, so as to lie over the seat of strangulation, usually Gimbernat's ligament.

The varieties here are best given in Sir James Paget's words : " In some instances, as you trace up the neck of the sac, you find it tightly banded

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[1] Sir J. Paget (loc. supra cit., p. 112) says : " If I were asked which of the signs of strangulation I would most rely on as commanding the operation, I should certainly say the vomiting." Later on (p. 114) he urges that the practitioner should not wait for any characteristic mode of vomiting, nor be misled by the absence of any particular fluid, nor even by the absence of all vomiting, nor underestimating the importance of occasional vomiting as a signal for operation.

[2] While general anæsthesia will be preferred in most cases from the more certain loss of sensibility and the relaxation of the parts, local or spinal anæsthesia may be used with great advantage when a general anæsthetic is contraindicated, especially by bronchitis.

[3] The operator can also manage very well with scissors, keen-edged but blunt-pointed, first nicking each layer, and then separating it from the next with the closed points.

across by a layer of fibrous tissue called Hey's ligament—a layer traceable as a falciform edge of the fascia lata, where that fascia, bounding the upper part of the saphenous opening, is connected with the crural arch, and is thence continued to Gimbernat's ligament. Sometimes a fair division of this layer of fibres up to the edge of the crural arch is sufficient to render the hernia reducible. . . . But in many cases this is not sufficient, and you may feel the stricture formed by bands of fibres which encircle the neck of the sac, and which must be divided, band by band and layer by layer, till none can be felt. These fibres are part of the deep crural arch. Very rarely, however, even the division of these is not sufficient, for the stricture is formed by thickening of the mouth of the
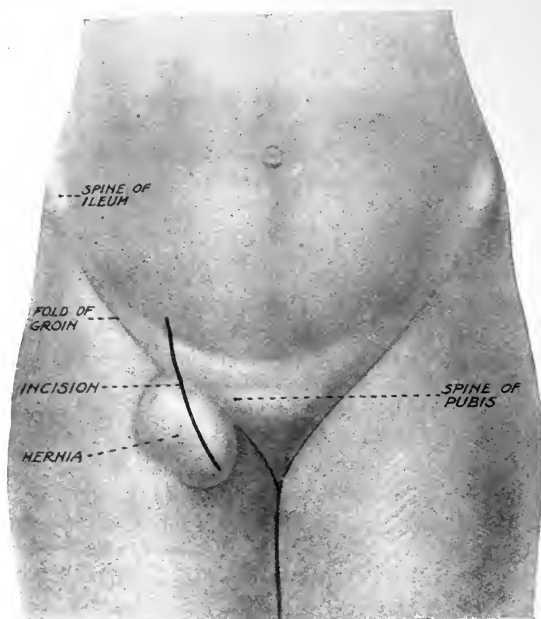
FIG. 12. Site of incision for strangulated femoral hernia.

sac itself. This condition, which is a common cause of stricture in inguinal hernia, is very rare in femoral; but it certainly does occur." [1]

Opening the Sac. The sac must always be opened, because of (1) the great importance of examining the bowel; (2) the dangers of opening the sac are negligible, whereas the dangers of reducing the hernia without opening the sac are great; (3) it renders an attempt at radical cure possible, and this should be done in all patients who are not *in extremis*.

In this and in the former case much difficulty is occasionally met with in deciding as to whether the sac is reached or no. The causes of difficulty here are mainly: (1) an altered condition of the soft parts from the pressure of a truss, or from long strangulation; (2) from meeting with fluid outside the sac; (3) from the extreme thinness of the

[1] In trying to divide points of stricture outside the sac attention should be paid to the following : (1) First reaching the sac itself, if possible, by a careful division of all the overlying structures in the incision carried well upwards ; (2) carefully drawing down the sac, so as to expose any fibres constricting its neck ; (3) gently insinuating the point of the director under any bands met with.

patient, which leads to the sac being reached unexpectedly ; (4) from the opposite condition, much fat being met with in several of the deep layers, making it uncertain which is the extra-peritoneal layer, the fat in these cases being often soft, and readily breaking down under examination ; (5) an apparently puzzling number of layers—this condition is usually due to " hair-splitting " over-carefulness on the part of the operator, at other times it is brought about by a much thickened fascia propria separated into imperfect layers by its softened condition or inflammatory matting ; (6) by the absence of a sac.[1]

Aids in Recognising the Sac in Cases of Difficulty. Several of those ordinarily given [2]—*e.g.* " its rounded and tense appearance, its filamentous character, and the arborescent appearance of vessels on its surface "—are, I think, quite fallacious. So, too, with regard to the escape of fluid from the sac, for this is often dry in femoral hernia, and occasionally fluid is met with before the sac is reached. A smooth lining characteristic of its inner surface is more reliable, but the inner surface of the fascia propria is sometimes remarkably smooth. The hernial sac is denser than any of its coverings, and is of a bluish-white colour. It may be so thin that fluid and bowel may be seen within it; it can often be pinched up and moved upon its contents. Moreover the omentum differs from the extra-peritoneal fat in having much larger and characteristic veins. Two points remain which will help to solve the doubt : (*a*) To draw gently down the doubtful structure, whether sac or bowel, and to examine whether it is continuous above and below with the structures of the abdomen and thigh, like the other coverings of the hernia, or whether it has a distinct neck to be traced into the abdominal cavity. (*b*) To see if the point of a director can be insinuated along this last doubtful layer into, and moved within, the peritoneal cavity or no. In a very few cases the surgeon, if still in doubt, incises carefully the suspected layer, and tries to pass in a probe and move it from side to side ; if this can be done, he is still outside the bowel, not between the peritoneal and muscular coats of intestine. The difficulties here are, however, so great that several operators have reduced a femoral hernia *en masse* during the operation of herniotomy, and others have only prevented this catastrophe by great care. The fascia propria has been mistaken for the sac, and the subperitoneal fat for the omentum ; this has been reduced into the extra-peritoneal tissues just above the femoral ring, the bowel remaining strangulated in the displaced sac. To avoid this catastrophe it is always wise to pass a blunt dissector well into the abdomen. There is no difficulty in doing this if the sac has been opened.[3]

The sac, being carefully nicked with the scalpel-blade held horizontally at a spot where it can best be pinched up with dissecting forceps—a matter of much difficulty at times, owing to its tenseness—is slit up on a director, and its contents examined. The escaping liquid, which may be septic, is carefully mopped away. If omentum first present itself, this is drawn to one side and unravelled, and intestine sought for. This usually takes the form of a small, very tense knuckle, of varying colour and condition. If it will facilitate the manipulations needful for

[1] A sac is said to be absent in some cases of hernia of the cæcum, and where the patient has been operated on before. This, however, was not the case in three herniæ containing the cæcum, and in two which had been operated on before, that have come under my care.

[2] Erichsen.

[3] *See* Rowlands " Reduction en Masse," *Guy's Hosp. Reports,* vol. lvi.

reduction, the omentum may be first dealt with. (1) If this be voluminous and altered in structure, it should be tied, bit by bit, with strong catgut, and then cut away. For security's sake the ligatures should be made to interlock. After the return of the intestine the stump is also replaced within the abdomen. (2) If the omentum be small in amount and recently descended, it may be merely returned.

Reduction of the Intestine. As soon as this is exposed the surgeon examines with the little finger, or a Key's director, the tightness of Gimbernat's liga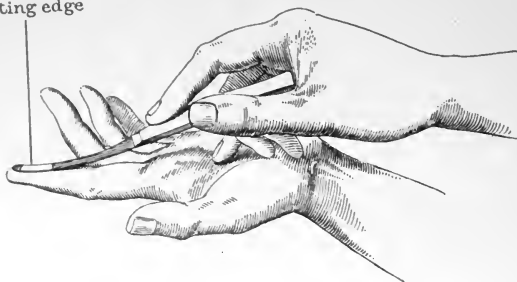ment. In a few cases reduction may be at once effected by gentle pressure backwards on the bowel with the tip of the little finger. But in the large majority the stricture will need division—a point requiring much carefulness for fear of injuring the intestine or important surrounding structures. If the degree of tightness of the parts admit of it, there is no director so safe and satisfactory as the index or little finger of the left hand passed up to the stricture, the hernia-knife being introduced along the pulp of the finger. But there is rarely room for this, and a Key's director [1] must usually take the place of the finger. The tip of this instrument being insinuated into the peritoneal cavity just under Gimbernat's ligament, the hernia-knife [2] is introduced obliquely or flatwise upon it, its end slipped under and beyond the ligament, its edge turned towards the constricting fibres, and a few of these gently cut through in an upward and inward direction. In doing this it is well for the surgeon to draw down the edges of the cut sac close to its neck and to ask an assistant to hold these, thus facilitating the passage of the director and the knife by preventing the sac falling into folds before them. Occasionally, also, a knuckle of intestine persistently coils over the edge of the director. This is best met by patience, by drawing it out of the way by the finger-tip of an assistant, or by pressing it down with the handle of a pair of dissecting forceps.

Cutting edge

Fig. 13.   Hernia knife guided by left index finger.
(Fergusson.)

The direction and the extent to which the stricture must be cut are matters of much importance. The upward and inward line is the only path of safety. Directly outwards lies the femoral vein ; by cutting upwards, the spermatic cord, and, if upwards and outwards, the epigastric artery, would be endangered ; behind are the peritoneum and pubes. The incision upwards and inwards must be of the nature of a nick ; otherwise, owing to the imperfect healing of the fibrous structure,

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[1] This director is broad, so as to prevent any intestine curling over and reaching the knife ; blunt-pointed, so as not to damage the contents of the peritoneal cavity ; finally, its groove does not run quite up to the end, so that the knife-point shall be stopped before it comes in contact with the important parts.

[2] A curved one will be found most useful. The cutting blade is usually too broad and the tip too massive. On the other hand, a worn-down blade has been known to break while dividing a tense Gimbernat's ligament. The intestine may thus be wounded, or the fragment of the knife escape into the peritoneal cavity.

the ring will be left large and gaping, thus facilitating the re-descent of the hernia, producing much difficulty in fitting trusses, and causing certain discomfort and probable peril to the patient, especially if she belong to the poorer, hospital class.

Gimbernat's ligament having been carefully and sufficiently nicked, the bowel is gently drawn down and examined, especially where it was
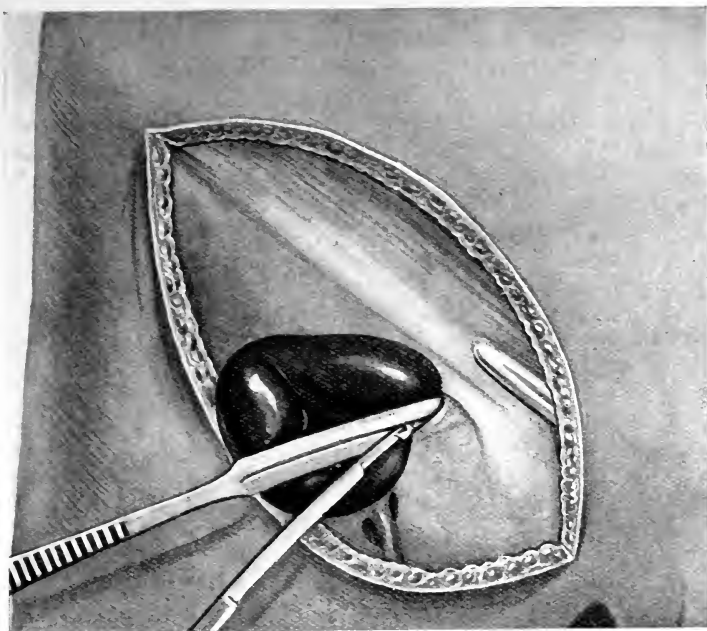
Fig. 14. Hernia knife passed along hernia director to divide the neck
of the sac.

constricted. If it is healthy it is replaced either by gentle squeezing between the finger and thumb, so as to empty it of its contents, or with the pressure of the little finger, the sac being now kept stretched with forceps so that no folds interfere with the return of the bowel.   If pressure on one part of the intestine fail, it must be tried at another point.   After the reduction of the intestine a finger should be introduced through the crural canal into the peritoneal cavity to ascertain that the gut is absolutely safe within the peritoneal cavity and not kinked round omentum adherent at the neck of the sac.

If the patient's condition admit of it, and if the adhesions are not too firm, the sac should next be removed after rapidly separating it by gauze dissection from its attachments. It should then be pulled well forwards and its neck ligatured with catgut as high up as possible, and the sac cut away half an inch below the ligature. Unless the condition of the patient is grave, or the tissues have been infected from foul contents of the sac, the femoral ring is closed in one of the ways described at p. 65. The superficial wound is closed with fishing-gut. The dressings are applied with sufficient care to keep the wound secure from obviously close sources of contamination.

The account of an ordinary operation having been given, it remains to consider certain **complications.** These are chiefly :

(1) Adhesions of Bowel to the Sac or Omentum. The treatment of this uncommon complication must vary with (a) the character and position of the adhesions, (β) the condition of the intestines, and (γ) the state of the patient. Owing to the difficulty of fitting on a truss if any of the hernia is left unreduced, every attempt should be made to free the contents by separating the adhesions with the point of a steel director. When near the neck they must always be divided, sufficiently nicked, or stretched. No intestine and omentum still adherent to each other should ever be returned. A few cases remain in which adhesions should be left alone. When gangrene is threatening, but the operator is too short-handed to face resection of the affected intestine, the presence of adhesions, especially about the neck of the sac, is the chief safeguard against extravasation into the peritoneal cavity. In some cases of large hernia, if the patient be much collapsed, so long as any recently descended loop is returned any long-adherent intestine may be left. And in other cases of collapse from delay of the operation, where there is much difficulty in returning a loop of intestine, especially if this be not in good condition, it may be left, after the stricture has been sufficiently divided.

It occasionally happens in these cases of deeply congested bowel, especially in inguinal hernia, that after an otherwise successful herniotomy the patient passes profuse and bloody stools. This condition may prove fatal. In one or two cases of this kind which have come under my notice the operator was, most unfairly, blamed for having incised the bowel.

(2) Tightly Constricted or Gangrenous Intestine. In spite of all that has been taught about the importance of early operations, cases do still occur in which returning the bowel is doubtful or out of the question. Nothing is more difficult than to decide upon the treatment of the intestine in doubtful cases. A prompt decision must be made after a careful examination of the intestine, mesentery, and contents of the sac, and the general condition of the patient will influence the decision.

(a) The Intestine. In some cases of doubt, as long as the stricture is sufficiently divided and the intestine placed only just within the crural ring (the wound being left open and the sac not ligatured), the interior of the abdomen is the best place for the intestine. And this is true of congested intestine, however deeply loaded with blood only, as long as there is some shade of red present. But on these points nothing will surpass the advice of Sir J. Paget : [1] " You are to judge chiefly from the colour and the tenacity. Use your eyes and your fingers ; sometimes your nose ; very seldom your ears, for what you may be told about time of strangulation, sensations, and the rest is as likely to mislead you as to guide aright. As to colour . . . I am disposed to say that you may return intestine of any colour short of black, if its texture be good ; if it feel tense, elastic, well filled out, and resilient, not collapsed or sticky ; and the more the surface of the intestine shines and glistens, the more sure you may be of this rule. When a piece of intestine is thoroughly black, I believe you had better not return it, unless you can be sure that the blackness is wholly from extravasated blood. It may not yet be dead, but it is not likely to recover ; and, even if it should not die after being

[1] *Loc. supra. cit.*, p. 138.

returned, there will be the great risk of its remaining unfit to propel its contents, and helping to bring on death by what appears very frequent—distension and paralysis of the canal above it.   But, indeed, utter blackness of strangulated intestine commonly tells of gangrene already ; and of this you may be sure if the black textures are lustreless, soft, flaccid or viscid, sticking to the fingers, or looking villous.   Intestine in this state should never be returned.   Colours about which there can be as little doubt, for signs of gangrene, are white, grey, and green, all dull, lustreless, in blotches or complete over the whole protruded intestine. . . . Then as to the texture of the intestine ; it should be, for safety of return, thin-walled, firm, tense, and elastic, preserving its cylindrical form, smooth, slippery, and glossy.   The further the intestine deviates from these characters, the more it loses its gloss and looks villous, the more it feels sticky and is collapsed and out of the cylinder form, the softer and more yielding, the more pulpy, or like wet leather or soaked paper, the less it is fit for return."   It is very important to notice whether the blood returns quickly or sluggishly to a portion of the loop of bowel which has been rendered anæmic by the pressure of the finger.   It should always be remembered that, although the bowel may not be actually gangrenous, it may slough or perforate soon after its reduction, and that in many more cases, without any perforation, the intestinal wall may be so severely damaged as to allow the escape of the virulent germs within it into the peritoneal cavity, inducing rapidly fatal peritonitis.   A number of patients also die from paralytic distension, and a few from enteritis, or profuse hæmorrhage from the bowel.   The dangerous condition of the distended bowel above the obstruction is too apt to be forgotten ; it is often in a condition of infiltrating septic inflammation, and its contents are highly poisonous, and owing to paralytic distension drainage is rarely successful in removing this toxic accumulation.

A consideration of the following Table inclines us to agree with Mr. Barker's statement that more than one half of the deaths after herniotomy are due to the reduction of too severely damaged bowel :

Causes of Death in Cases Dying after Operation
for Strangulation

(From a paper by Mr. Barker, *Lancet*, May 30, 1903)

Sepsis	2
Sloughing	12
Peritonitis	43
Collapse	17
Asthenia	14
Lung troubles	16
Heart failure	2
Hæmorrhage	1
Obstruction	3
Anæsthetic	2
Lung embolism	2
	114
Unascertained	13
Total	127

(*b*) If the mesentery is greatly thickened and firm from inflammatory œdema or intestinal hæmorrhage, if its veins are thrombosed and its

arteries cannot be felt to pulsate, then it is clear that the loop of bowel ought not to be returned into the abdomen.

(c) The nature of the fluid in the sac is also of importance, for if it be foul and sanious it indicates that the condition of the loop of bowel is so bad as to allow infection through the damaged walls, and the risk of peritonitis incurred by returning such intestine is great. Moreover some of the septic fluid may trickle into and infect the peritoneum.

In other long-standing cases of femoral hernia the chief stress of the constriction is shown, not on a dying loop of intestine, but in ulceration, partial or nearly ring-like, at the neck of the sac, under the sharp edge of Gimbernat's ligament. Where this condition, owing to the duration of the case, is suspected the intestine should be very gently drawn down and carefully examined ; if only a grey or white line be found, this may be inverted by means of a Lembert suture and fortified by a mesenteric flap or omental grafts, and the bowel, which is otherwise recoverable, may be returned. It is also important to examine the condition of the distended bowel above the obstruction. If this is good a damaged loop of bowel may often be safely returned after making a lateral anastomosis between the bowel above and below the loop. The risk of perforation is thus diminished and a more dangerous resection is avoided. The damaged loop is left just above the neck of the sac, which is not closed. The alternative of leaving a doubtful loop of bowel in the wound for twenty-four hours after dividing the stricture is not so satisfactory, for the bowel is more likely to recover when returned into the abdomen, where adhesions soon take place between it and the neighbouring coils.

When it has been decided that the bowel cannot be reduced without undue risk, the surgeon has to decide between (a) the formation of an artificial anus, and (b) resection. Wherever possible, i.e. in cases where the condition of the patient, and the experience, and help ready to the surgeon's hand admit of his taking this step, the gangrenous intestine should be resected.

(a) In a few cases where the above conditions are absent the surgeon must rest content with opening the intestine, leaving it in situ, and thus draining the distended bowel above. The quickest way will be to draw the whole loop that is damaged outside the peritoneal sac and keep it in place by a sterilised bougie or glass rod of appropriate size, as in inguinal colotomy.

It has been much disputed whether in these cases, when the intestine is unfit to be returned, it is safe or needful to divide the stricture in addition to laying open the intestine. On the one hand, M. Dupuytren, Sir A. Cooper, Mr. Key, and Sir J. E. Erichsen advocated this step being taken ; on the other, Mr. Travers and Sir W. Lawrence were against it, fearing spreading infection of the peritoneum from the sac. This fear is now known to be groundless ; moreover without division of the stricture the distended bowel above it cannot be drained efficiently. A small incision is made on the convexity of the loop and a long rubber tube with two side-holes near its inner end is passed along the distended intestine within the abdomen. It is secured to the bowel by a suture, which also closes the aperture around the tube. It is unfortunately true that, although the tube may be passed well into the distended bowel within the abdomen, very little of the pints of putrescent fluid drains away in the worst cases owing to paralysis of the intestine. When the condition of the patient allows, an entero-anastomosis is made between the bowel above and below the

obstruction. The entero-anastomosis is returned into the abdomen and the damaged loop is retained in the wound. A secondary operation for closing the fæcal fistula is thus ·either avoided or simplified. Few cases which are so desperate as to be suitable for the formation of an artificial anus ultimately recover. In a series of 406 cases of strangulated hernia at University College Hospital [1] only two out of twenty recovered after this procedure. The reasons for this high mortality are chiefly the desperate general condition of the patient at the time of the operation, which is followed by shock, septic peritonitis from the condition of the distended bowel within the abdomen, suppuration and sloughing in the wound, and lastly the mortality of the secondary operation, which is usually necessary to close the fæcal fistula, is high in these cases. Shock and pulmonary complications can be minimised by doing the primary operation under eucaine anæsthesia as recommended above.

(b) *Resection.*[2] The present high mortality of strangulated hernia will be very considerably lowered by the adoption of primary resection in suitable cases under favourable circumstances.

It is important to remember that resections are rarely wide enough ; it is of little use to resect the strangulated loop without also removing the distended paralysed bowel above the obstruction. Mr. Barker [3] has laid great stress on the removal of enough of this inflamed and damaged bowel ; up to six feet of small intestine may be removed, if necessary, without materially increasing the shock of the resection and without interfering seriously with subsequent nutrition. Between 1899 and May 1903 Mr. Barker performed seven extensive enterectomies for strangulated hernia with only two deaths, one of these dying from the pressure of an old fibrous band on the bowel after its return into the abdomen, and another from peritonitis, which was probably due to infection from a suppurating hernial sac, which was not drained externally. Hofmeister [4] also publishes twenty-five primary resections with a mortality of 40 per cent.

Mr. Barker states that the marked diminution in the mortality of herniotomies at University College Hospital during the four years 1899 to 1903 was due almost entirely to the success of extensive resections performed in suitable cases. During these years the mortality was reduced from about 25 to 30 per cent. to 18 per cent.

It is perhaps needless to say that these extensive resections can only be undertaken by surgeons skilled in intestinal surgery and on patients whose general condition is fairly good. For those patients presenting themselves when *in extremis* the formation of an artificial anus under local or spinal anæsthesia still remains the most suitable treatment.

(3) Wound of Intestine. This may be due to (*a*) carelessly incising thin, soft parts ; (*b*) great difficulty in making out the sac and the intestine in a fat patient, with the parts matted, especially if the light is bad ; (*c*) to the intestine being allowed to curl over the edge of the director while the stricture is being divided, or to this being cut with careless freedom, or, lastly, to a loop lying out of sight just above the constriction, and to the hernia-knife coming in contact with this. Any bubbling of flatus or escape of fæces must lead to a careful search for the wound. The operation wound being freely enlarged, the wound

[1] Barker, *loc. supra cit.*
[2] The operation of Resection is described in Chapter XIX.
[3] April 27, 1901, and *loc. supra cit.*
[4] Beit. Z. Klin., Bd. xxviii, H. 3.

in the intestine found, temporarily closed with a Spencer Wells's forceps, and drawn quite out of the abdomen, the intestines around are carefully cleansed and packed out of the way. When the wound in the intestine is small it may usually be inverted and closed by means of a purse-string suture of fine silk which picks up only the serous and some of the muscular coat. If the opening be larger it should be closed by two layers of suture, without narrowing the lumen of the bowel (see Suture of the Intestine). Whichever method is used, the injured part should be replaced just within the peritoneal cavity.

(4) Wound of Obturator Artery. The position of this vessel when it rises by a common trunk with the deep epigastric instead of from the internal iliac, which occurs in two out of every seven (Gray), may bear a very important relation to the crural ring. In most cases when thus arising abnormally the artery descends to the obturator foramen close to the external iliac vein, and therefore on the outer side of the crural ring and out of harm's way. In a small minority of cases the artery in its passage downwards curves along the margin of Gimbernat's ligament, and may now be easily wounded.

The treatment is mainly preventive—i.e. by making the smallest possible nick that will be sufficient into any point of stricture, such as Gimbernat's ligament, a point the importance of which has already been alluded to (p. 20), and by using a hernia-knife that is not over-sharp, and above all by opening the inguinal canal after Lotheissen's method of radical cure and seeing Gimbernat's ligament from above, an abnormal artery is thus easily seen and avoided. If the artery has been wounded, the following points are of interest : (1) The hæmorrhage may not at once follow the wound. It may not make its appearance till the bowel is all reduced, or even until a quarter of an hour after the wound has been stitched up. In one case, that of Dupuytren, no hæmorrhage occurred, and the division of the artery was discovered for the first time at the necropsy three weeks after the operation. (2) It may occur when the sac has not been opened. (3) As is shown by Dupuytren's case, it is not necessarily a fatal accident. (4) Very various means have served to arrest the hæmorrhage. (a) Pressure, as in the cases of Sir W. Lawrence, Mr. Hey, and Mr. Barker.[1] This means was successful in two out of the three cases in which it has been employed. It should only be resorted to when the patient's condition does not admit of the bleeding points being found and dealt with by ligature. If pressure has to be trusted to, it should be efficiently employed by means of sterile gauze. (β) Ligature of the vessel, usually the proximal end. Of five cases given by Mr. Barker this was successful in four ; it is only stated in one that the distal end was also secured. The ligature had been applied in some cases by continuing the wound upwards ; in others by making an incision parallel with Poupart's ligament, as if for tying the external iliac. The best way to expose the artery is through the inguinal canal after Lotheissen's method of radical cure of femoral hernia (p. 68) ; both ends of the artery must be tied.

Causes of Persistence of Symptoms after Herniotomy (see Table on p. 23). Most of the bad results are due to one or both of the following causes :

(a) The reduction into the abdomen of bowel in a severely damaged state.

[1] *Clin. Soc. Trans.*, vol. xi, p. 180. This paper will well repay perusal.

(*b*) The operation is still frequently too long delayed.

(1) Peritonitis, indicated by general abdominal tenderness, rigidity, tympanites, and vomiting. (2) Collapse from exhaustion. (3) Lung · complications such as bronchitis, septic pneumonia, pulmonary embolism. (4) Sepsis, suppuration in the wound, erysipelas, sloughing of the bowel or wound, septicæmia. (5) Enteritis and hæmorrhage from the bowel. The eight following are the causes of intestinal obstruction after operations for hernia : (6) The descent and restrangulation of the bowel. (7) So much damage to the intestine that it lies paralysed in the peritoneal cavity.[1] (8) Cicatricial stricture of the intestine. (9) Fixing of the bowel, after its reduction, by adhesions to the abdominal wall. (10) Formation of a band out of the above adhesions. (11) Fixing of the two ends of a loop of intestine by adhesions. (12) Formation of an omental band in the neighbourhood of one of the hernial orifices, a band so formed causing obstruction later.[2] (13) A very rare condition.

The sac may be multilocular ; when the intestine is reduced it may be returned into one of these cavities instead of within the abdomen. Mr. Bellamy has published such a case.[3] A good illustration of this is given in Mr. Holmes's *Surgery*, p. 698, Fig. 322 : the patient here died eight days after an operation for strangulated hernia. (14) Reduction *en masse* at the operation. This is most likely to happen in femoral hernia, the fascia propria being mistaken for the sac.

STRANGULATED INGUINAL HERNIA

Operation. In considering this it will not be needful to go again into detail, as in the case of Strangulated Femoral Hernia ; the chief points of difference and those of importance will be considered carefully.

The parts being shaved and cleansed, and the thigh a little

FIG. 15. The site of the incision for strangulated inguinal hernia.

flexed, an incision four inches long at first is made in the long axis of the tumour, with its centre over the internal abdominal ring. The superficial epigastric vessels are secured and tied. As the layers are divided, the knife

[1] Mr. Jacobson recorded (*Brit. Med. Journ.*, 1879, vol. ii, p. 491) an instance of this in which, ten days after an operation for intestinal obstruction by bands, death took place from the intestine never having recovered itself.

[2] *Brit. Med. Journ.*, 1879, vol. ii, p. 491.   [3] *Lancet*, 1886, vol. ii p. 433.

being kept strictly in the same line throughout, the tendinous fibres of the external oblique are exposed with some arching fibres of the inter-columnar fascia below. The inguinal canal is freely opened, and the cremasteric fascia, often thickened, is identified and incised. After this the transversalis fascia, also much thickened and vascular-looking, is slit up, and any extra-peritoneal fat overlying the greyish-blue sac looked for. The surgeon now sees if he can find any constricting fibres outside the sac, and slits them up on a director. The sac is opened with the precautions already given (p. 19), the contents are thoroughly examined, omentum got rid of if this step will give more room, and the site of stricture [1] found with the finger or tip of the director. It is next divided with the hernia-knife manipulated under it in a direction straight upwards, so as to lie parallel with the deep epigastric, whichever side of the hernia this vessel occupies.[2] During this stage the steps given at p. 20 must be taken to avoid any injury to the intestine. The constricting point being divided and dilated, the next step is **reduction of the intestine.** This, in bulky inguinal herniæ, is often a matter of difficulty and time. The **chief causes of difficulty here** are : (1) A large amount of intestine, one or two coils of small and some large intestine being not very un-common. (2) The distension of these with flatus, &c. (3) Insufficient division of the stricture, or there may be a point of stricture higher up than the one divided, and overlooked. (4) During attempts at re-duction one bit of intestine may get jammed across the ring instead of slipping up along it, and against this the rest of the contents are fruit-lessly pressed. (5) Folds of the sac may in much the same way block the opening.

Aids in Difficult Cases. First, that part which lies nearest the ring should be taken, e.g. mesentery before intestine. After each part is got up, pressure should be made on it for a few seconds before another is taken in hand. If the surgeon find, after a while, that he is making no progress with one end of a coil, he should take in hand the other end, or another coil altogether if more than one be present. Much of the difficulty met with in the reduction of the intestine is due to the surgeon not first unravelling the coil or coils, not duly tracing up the intestine to the ring so as to make out the relations of the two, and, above all, to his not making up his mind which end of the coil it is exactly which he intends to begin reducing. During the manipulations the thigh should be flexed and rotated a little inwards, and the cut edges of the sac drawn tense with forceps, so as to prevent any folding or pushing up of this before the intestine. If the intestines are much distended attempts should be made to return some of their contents first into the

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[1] The site of the stricture in inguinal hernia varies. In both varieties, in old cases of long duration, it is usually situated in the neck of the sac itself, owing to contraction and thickening of this and the extra-peritoneal tissue. In other cases of oblique hernia the stricture is found in the infundibuliform fascia at the internal ring, just below the edge of the internal oblique in the canal, or at the external ring. In a direct hernia the constricting point, if not in the sac, is probably caused by the fibres of the conjoined tendon. In many cases the parts are so approximated and altered that in the short time given for an operation it is not so easy to tell exactly in what tissues lies the strangulation as to relieve it. Finally, in many cases of young subjects and acute strangulation muscular spasm, e.g. of the internal oblique, must be borne in mind.

[2] Of course, if the surgeon is certain that he is dealing with an oblique hernia he may cut outwards, and, in the case of a direct hernia, inwards, so as to avoid the deep epigastric. In all cases the cut should be of the nature of a nick dividing only those fibres which actually constrict, any additional dilatation being usually now effected by the tip of the director or finger.

abdominal cavity. If, after gentle squeezing with the finger and thumb, and careful pressure upwards on each successive bit of intestine, it all appears to be returned, the index finger must be passed into the abdominal cavity to make certain that no knuckle remains in the canal or internal ring.

Cases will occasionally be met with where, owing to the low condition of the patient, the large amount of intestine down, its great distension, its altered condition, still red and only congested, but softened, with the peritoneal coat shaggy rather than lustrous, and tending to tear easily, it is clear that reduction will not be effected by manipulation only. After carefully packing round a distended loop flatus may be released by puncturing with a fine trocar or an ordinary triangular needle. If this does not relieve the distension liquid fæces may be drained away through a cannula and a long piece of rubber tubing. The perforation is closed and inverted by means of a purse-string suture, introduced before the puncture is made, and tightened as the cannula is withdrawn. The bowel is cleaned with saline and replaced in the abdomen. Where the intestine is much congested and softened, though not yet gangrenous, or where the surgeon has not skilled assistance and all the aids of modern surgery ready to his hand, he had better leave the intestine in the sac after a free division of the stricture.[1] This method, while under the above conditions the safer, prevents, of course, any attempt at relieving the patient, at one operation, by a radical cure. For a consideration of the points which may aid in deciding on the treatment of bowel in a doubtful condition, or in a gangrenous state, the reader is referred to p. 22.

During any prolonged manipulation of the intestines these should be kept covered as much as possible by sterile gauze wrung out of hot saline solution. It is wise also that the patient should be well under the anæsthetic now, and breathing quietly. If vomiting occur, the surgeon must wait, keeping up pressure on what he has reduced. When the intestine is all reduced, any ligatured stumps of omentum are returned, and, if the condition of the patient admit of it, the sac is detached, one of the methods of radical cure given at pp. 47 to 62 made use of, the precautions as to the cord and other points given at p. 45 being carefully followed.

After thus considering the chief points in the operation, it remains to draw attention to **some special points connected with inguinal hernia**.

I. *Varieties*. In addition to the oblique and direct varieties, both of which are acquired, there are some others of much practical importance, *e.g.* (*a*) Congenital hernia into the funicular process of peritoneum. Here the tubular process of peritoneum is divided into a shut vaginal

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[1] This will all gradually and slowly return into the peritoneal cavity. On this point the following case by South (Chelius's *Surgery*, vol. ii, p. 40) is of interest : "I know by experience that if strangulation be relieved it is of little consequence how much intestine be down. In reference to this point, I recollect the largest scrotal rupture on which I have operated, and in which, before the division of the stricture, there was at least half a yard of bowel down, filled with air ; and, after the stricture had been cut through, at least as much more thrust through, so that I almost despaired of getting any back ; yet, after a time, I returned the whole. To my vexation, however, next morning I found that my patient had got out of bed to relieve himself on the chamber-pot, and, as might be expected, the bowel had descended, and in such quantity that the scrotum was at least as big as a quart pot, and the vermicular motion of the intestine was distinctly seen through the stretched skin. Nothing further was done than to keep the tumour raised to the level of the abdominal ring, and by degrees it returned, and the patient never had an untoward symptom."

sac below and an open funicular process above. Into the latter the contents descend, but are not in absolute contact with the testis. (b) Congenital hernia into the tunica vaginalis ; the tubular process of the peritoneum is open from the abdomen to the fundus scroti, and the contents lie in contact with the testis. A careful study of the herniæ of infants and children proves that this variety is very much rarer than the first variety. (c) Hour-glass contraction of the sac. Here the tubular process is open as in (b), but an attempt at closure has brought about a constriction which may be at the external abdominal ring or lower down in the scrotum. If the contents pass through this constriction and get low enough, they will be in actual contact with the testis. (d) Encysted hernia of the tunica vaginalis. Here the funicular process is closed at its upper extremity, i.e. at either ring or in the canal, and open below to the testicle. The hernial protrusion as it comes down either ruptures this septum (when of sudden descent), or gradually inverts it, or comes down behind it. These cases are rare, but may be puzzling when they occur, as the operator has more than one layer of peritoneum to incise before reaching the contents. (e) Interstitial hernia, in which the sac, and often the testicle, lie between the internal and external oblique muscles. The writer recently operated on an infant in which the condition was bilateral ; there were no external rings, yet the cords were long enough for the testes to be easily brought within the scrotum.

That the above varieties have an importance beyond that of anatomical puzzles is shown by the fact that in (a), (c), and (d) strangulation may be very acute and urgent. Again, though the defect is a congenital one, the hernia does not, in many cases, make its appearance till the patient has, in early adult life, been subjected to some sudden strain. Finally, in these cases any prolongation of the taxis will be not only futile but actually dangerous, owing to the tightness of the strangulation and the facility with which, from the delicacy of its adhesions, the sac may be separated or burst.

II. *Reduction en Masse, and Allied Conditions.* These have been chiefly met with in inguinal herniæ owing to the loose connections of the sac and, sometimes, to the force used in attempts at reduction. Strangulation may persist after (a) displacement, or (b) rupture of the sac. In the former the sac, still strangling its contents, is displaced bodily between the peritoneum, usually, and extra-peritoneal fascia. In the latter the sac is rent, usually close to its neck and on its posterior aspect, and some of its contents are thrust through into the extra-peritoneal connective tissue. The chief evidence of these accidents is that, though the swelling has disappeared, perhaps completely, this has taken place without the characteristic jerk or gurgle. On close examination, though the bulk of the hernia is gone, some swelling, often tender, is usually to be made out, deep, in the neighbourhood of the internal ring. Above all, the *symptoms persist*, perhaps in an intensified form.

The treatment is immediate exploration of the inguinal canal and the internal ring. If the cord is exposed, the whole sac has probably been detached. If any of the sac is left in the canal, a rent in its neck should be sought for. If necessary the lower fibres of the internal oblique muscle may be incised to expose the displaced neck of the sac.

III. *Retained Testis simulating Hernia.* Such a testis, when inflamed, or twisted on its mesorchium, which is often long enough to allow this.

may closely simulate strangulated hernia. A testis, perhaps, has never descended; a truss has been worn and laid aside. The patient presents himself with a tender swelling in one groin, with indistinct impulse. The abdomen is tense and full, constipation is present, and perhaps vomiting of bilious fluid. Such a swelling should be explored and the testis removed, as it is certain, later on, to cause serious trouble, even if the present urgent symptoms subside with palliative treatment. In other cases a retained testis may draw down an adherent loop of intestine, which may become actually strangled.

STRANGULATED UMBILICAL HERNIA

Two distinct forms of strangulated hernia will be met with here. One, more rare, is of small size, with a single knuckle of intestine acutely strangled in the navel-cicatrix. The other, the more common, is often huge, its contents mixed, intestine both large and small, and omentum. Such herniæ soon become, in part at least, irreducible; when in this condition any unwise meal may readily bring about obstruction, a condition requiring much care to tell from strangulation.[1] In other cases a large irreducible hernia may easily become strangulated from the descent of some additional loop of bowel. The adequate fitting of a truss is often a matter of much difficulty here, owing to the large size of the abdomen, the presence of adherent omentum, and, frequently, of an habitual cough.

Practical Points before Operation. (a) The sac usually communicates directly with the general peritoneal cavity by a large opening. (β) The contents are not only mixed, but of long standing, and often adherent. (γ) The patients are often advanced in life, obese, flabby, and not infrequently the subjects of chronic bronchitis. (δ) The coverings are ill-nourished and slough easily.

Operation. In view of the delicacy of the skin and the intertrigo which is often present, the cleansing must be thorough but gentle. An anæsthetic having been administered, a curved transverse incision two to three inches long is made across the lower [2] aspect of the *neck of the swelling*, the hernia being pushed upwards to facilitate this.[3] The coverings are much thicker and more easily distinguished here than over the fundus of the hernia, where it is easy to injure the contents. Moreover the contents are rarely adherent at the very neck of the rupture. The

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[1] Amongst the most important points will be the vomiting, whether early in onset, constant, and showing signs of becoming fæculent, and the constipation, whether absolute, even to the passage of flatus. In doubtful cases the rule should be to operate. " The risk of operating on a hernia which is inflamed and not easily reducible is very small in comparison with the risk of leaving one which is inflamed and strangulated; and even if you can find reasons for waiting it must be with the most constant oversight, for an inflamed and irreducible hernia may at any time become strangulated, and will certainly do so if not relieved by rest and other appropriate treatment " (Sir J. Paget, *loc. supra cit.*, p. 106).

[2] The lower part is here recommended because, in Mr. Wood's words (*Intern. Encycl. of Surg.*, vol. v, p. 1165), " the point of strangulation in an adult umbilical hernia is most frequently at the lower part of the neck of the sac, where the action of gravity, the dragging weight of the contents, and the superincumbent fat, together with the pressure and weight of the dress or an abdominal belt, combine to press downwards upon the sharp edge of the abdominal opening. It is here that adhesions and ulceration of the bowel are most frequently found, and here the surgeon must search for the constriction in cases of strangulation." An incision here also gives better drainage when necessary.

[3] If the surgeon intends to attempt a radical cure, and if the skin is diseased, much thickened with old abrasions, he should remove this area by two elliptical incisions.

ring, and the aponeurosis for two inches below it, are thoroughly exposed. The sac must be opened, with the knife held horizontally, and slit up, care being taken now and throughout the operation, in cases of large herniæ, that protrusion of intestine be prevented by the means given a little later. The contents having been examined, any intestine is gently displaced upwards, while the surgeon turns the curved surface of a Key's director over the edge of the opening, and, guiding the hernia-knife on this, divides the constricting edge laterally. If sufficient space is not given, the nick may be repeated, or the director turned against the other side of the ring, and some fibres here also divided.

Adhesions of the contents of the sac are not infrequently met with. If they are very close and dense, and if the condition of the patient is unsatisfactory, and if the surgeon be short-handed, he should be content with a free division at one or two places of the constricting ring, and with reducing any portion of intestine that has clearly only recently come down, and leave the rest undisturbed.

In late cases care must be taken to prevent protrusion of the intestines from the abdomen by vigilant pressure and deep anæsthesia. If the bowels are allowed to prolapse it may be very difficult to replace them, and the manipulations required increase shock and toxæmia.

All the intestine and the remains of the omentum, carefully ligatured, having been returned if possible, the surgeon now, if the patient's condition admits of it, removes the redundant sac and skin by joining the ends of the first incision by another one passing across the upper aspect of the neck of the rupture. The opening into the abdominal cavity is closed in the following manner : The sac is carefully separated all round till its neck is cleared, the redundant part is cut away, and the peritoneum closed by means of a continuous catgut suture. The operation is completed by rapidly performing one of the operations for radical cure which are described on p. 69. Mayo's operation is simple and by far the best. Attempts to draw the edges of the fibrous ring together without the aid of flaps are to be condemned, because the sutures are very apt to tear out even during the operation, and much more so during the vomiting that may follow it. The writer remembers two cases in which restrangulation occurred from this cause.

It will be seen from the above account that two methods may be pursued in the reduction of a strangulated umbilical hernia : (1) If the surgeon be short-handed and the hernia very large or the patient's general condition grave, the ring is freely divided at one or two points, but the contents disturbed as little as possible, any recently descended intestine being returned, but thickened omentum and adherent intestine (especially large) being left undisturbed. (2) Free opening of the sac, examination and separation of its contents, return of all intestine, and of omentum after ligature and excision of some of the latter.

While the second of these courses has the great advantage of leaving the patient permanently in a more satisfactory condition, as it admits of a radical cure, the surgeon can only rightly decide between this and the first course by a careful consideration of each case. The following points may aid in judiciously selecting either operation : (1) The size, long standing, previous attacks of incarceration and obstruction of the hernia, all these tending to bring about adhesions and alterations in the parts. (2) The condition of the patient, viz. the degree of flabby fatness, chronic bronchitis, probable renal and hepatic disease, amount

of depression by vomiting and pain. (3) The presence of the skilled help so essential in these cases. (4) The way in which the anæsthetic is taken. (5) The amount of experience of the operator. Thus a hospital surgeon, frequently operating and with all instruments and assistance at hand, may readily incline to one course, while the other may as wisely be followed by a surgeon who has to operate under very different circumstances.[1] For a consideration of the treatment of damaged intestine, *see* p. 22.

STRANGULATED OBTURATOR HERNIA

This form of hernia has occurred too frequently to be entirely passed over. It may be so readily and fatally overlooked that a few words on its *diagnosis* will not be out of place.

(1) Position of the swelling. This appears in the thigh below the horizontal ramus of the pubes, behind and just inside the femoral vessels, behind the pectineus, and outside the adductor longus. (2) On careful comparison of the outline of Scarpa's triangles, a slight fullness is found in one as compared with the hollow in the other. (3) Pain along the course of the obturator nerve, down the inner side of the thigh, knee, and leg. (4) Persistence of symptoms of strangulation, the other rings being empty or occupied by reducible hernia. (5) A vaginal or rectal examination. In making these examinations in cases of intestinal obstruction care should always be taken to examine the pelvic aspect of the obturator foramen.

Operation. Two different ones present themselves : (i) by cutting down on the sac, as in other herniæ ; (ii) by abdominal section, and withdrawing the loop from within.

(i) The parts having been duly cleansed and slightly relaxed, an incision is made parallel to and just inside the femoral vein and extending a little above Poupart's ligament. The saphenous opening being probably exposed in part, the fascia over the pectineus and the fibres of this muscle having been divided transversely for one and a half or two inches, the obturator muscle covered by its fascia and some fatty cellular tissue is next defined, and the hernial sac probably now comes into view, either between the muscle and the pubes, or between the fibres of the muscle. The sac must be opened, and if any constriction has to be divided, the knife should be turned either upwards or downwards, the latter being the easier if any constricting fibres intervene between the sac and the bone. As the obturator vessels lie usually on one side or the other, a lateral incision must be avoided.

Care must be taken to keep the femoral vessels drawn outward with a retractor, while any branches of the obturator or anterior crural nerve are drawn aside with a blunt hook, the same precaution being taken with the saphena vein.

When by the passage of the little finger into the abdomen it is certain that the intestine is reduced, if the condition of the patient admits of it the sac is separated and ligatured close to the thyroid foramen and removed.

[1] Mr. Clement Lucas (*Clin. Soc. Trans.*, vol. xix., p. 5) advocated more radical measures, such as excision of the sac and redundant skin, with suture of the ring, in all cases of umbilical hernia. Two successful cases are recorded, both excellent instances of this treatment, and one of especial interest, as the patient had been previously thrice tapped for ascites, and the operation allowed three pints and a half of fluid to escape.

(ii) The operation of abdominal section will, perhaps, be more frequently performed in the future.

An obturator hernia was thus reduced by Mr. Hilton in a case which simulated intestinal obstruction. Some empty intestine, being found and traced downwards, led to the detection of an obturator hernia, which was reduced by gentle traction, aided by firm pressure made deeply in the thigh. The patient, who was not operated on till the eleventh day, died of rapid peritonitis.

In 1914 I reduced a small gangrenous enterocele in this way in a feeble old lady on the fifth day of strangulation. Entero-anastomosis combined with drainage of the perforated loop proved successful. The anastomosis was 6 inches above and 3 inches below the perforation.

Before drawing the strangulated bowel into the abdomen it is important to introduce a gauze pack into the pelvis. The constriction is then nicked downwards with a hernia-knife, the intestine withdrawn and treated, and the hernial orifice closed from within the abdomen.

Question of the advisability of reducing Strangulated Hernia by Abdominal Section.

This question having arisen here may be dealt with once for all. Cases will occur from time to time, such as Mr. Hilton's,[1] in which, evidence of acute intestinal strangulation existing and no hernia being detected externally, on the abdomen being opened the cause will be found to be a piece of a small intestine nipped in part of its circumference, probably in either one of the femoral or obturator rings. Still more rarely a surgeon may find such difficulty in reducing an obturator hernia from without that he feels himself driven to resort to abdominal section. More frequently he may find the bowel gangrenous in an obturator hernia. It is to be remembered that the rupture is often a partial enterocele with dubious symptoms which have delayed treatment. If the patient's condition be fairly good, resection is then indicated, and can only be performed through a laparotomy wound. An incision should be made through the corresponding rectus low down, the Trendelenberg position adopted, and the limbs of the loop of bowel which are within the pelvis clamped with Doyen's intestinal forceps. The constriction should then be divided in a downward direction, and the strangulated intestine withdrawn into the pelvis and then out of the abdomen, where it can be thoroughly examined and resected if necessary. Should the sac be suppurating it can be drained through a wound in the thigh. Some years ago it was suggested that it should be the rule to reduce herniæ generally, and to perform the radical cure by abdominal section. Thus at the meeting of the British Medical Association in 1891 [2] this question was discussed, the late Mr. Lawson Tait introducing the subject. As might be expected, the proposal to abandon the old operation and treatment by median abdominal section met with no support from those surgeons who know anything of operations for strangulated hernia in hospital practice, especially in males. Save in the rarest cases, such as those belonging to the category I have mentioned, such a step is to be condemned in the strongest terms, for the following reasons : (1) Operations for relief of strangulated hernia must sometimes be performed by general practitioners. The old and well-established operation is one, *per se*, of but slight severity, and one that usually can be kept extra-peritoneal by an operator of ordinary skill and of average anatomical knowledge. Those who would substitute ab-

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[1] *Loc. supra cit.*   [2] *Brit. Med. Journ.*, September 26, 1891.

dominal section forget that, however safe they may consider themselves, with their especial experience, to be in preventing *peritonitis*—a very different standpoint from that of a general practitioner—neither they nor any one else can prevent the *shock* which goes with intra-peritoneal operations, a complication which is certainly to be avoided in patients exhausted by a strangulated hernia. (2) The reduction of the intestine, which is spoken of as so easy after abdominal section by those who advocate this method, is liable to be prevented by adhesions to the sac, &c. ; when such exist—and no one can foretell this point—the sac must be explored in the usual way. (3) There is a very grave risk that the intestine is tightly nipped, and often may give way when pulled upon through a median incision. Those who advocate abdominal section will say that the resulting extravasation can be met by flushing, &c. It will be well for all such to remember the following advice, tersely put by Sir W. Bennett : [1] " Let it be noted that it is generally far more easy to *soil* the peritoneum than to *cleanse* it." The same surgeon points out [2] that the fluid found in the sac of herniæ, when strangulation has long existed, is sometimes dark and ill-smelling, though no lesion may be apparent in the gut itself. By an ordinary herniotomy such fluid is thoroughly drained away from the peritoneal cavity, and any such intestine is cleansed before it is put back, or otherwise appropriately dealt with. (4) All operating surgeons are agreed that, whenever the condition of the patient admits of it, an operation for strangulated hernia should be completed by giving the patient at least a chance of radical cure. I am distinctly of opinion that no intra-peritoneal operation yet described will secure radical results in inguinal herniæ. (5) Those who think they are improving matters by substituting abdominal section for the old-established herniotomy object to the latter on account of its tendency to weaken the abdominal wall by the incision made to reach and relieve the constriction. Such advocates forget the criticism pithily put forward during the above discussion by Mr. Keetley, that treatment of herniæ by abdominal section created two potential hernial apertures where there was originally but one.

RADICAL CURE OF HERNIA

Before describing the different methods the following points claim attention ; and while the improvements of modern surgery have long established radical cure on a sound scientific basis, many questions have to be considered. The chief of these are : (1) The mortality of the operation. (2) The use of the terms " radical cure " and " permanence of the cure." (3) The earliest age at which the operation is advisable in children. (4) The advisability or need of wearing a truss afterwards. (5) The best material for suture. (6) The best form of operation.

(1) **The Mortality of the Operation.** The following statistics show what modern surgery and experienced hands can do : Drs. Bull and Coley [3] have compiled a list of 8594 cases, under the care, be it noted, of well-known operators, with seventy-eight deaths, giving the very low mortality rate of ·9 per cent. The same writers in a later publication [4] publish an analysis of 1095 of their own cases, with a mortality of only two—less than ·2 per cent. One of these died of ether pneumonia. Since these deaths

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[1] *Clin. Lect. on Hernia*, p. 122.   [2] *Ibid.* p. 121.
[3] *Ann. of Surg.*, vol. xxviii., 1898, p. 604.   [4] *Ibid.* June 1903.

Coley has performed 500 radical cures without a death. These authors also quote the mortality at Carle's Clinic in Rome as only two in 1400 operations, and at the Johns Hopkins Hospital, where an extensive operation is employed, as one in 459. Bull and Coley [1] publish a mortality of only ·3 per cent. in 1500 radical cures in children, mostly over four years of age.

(2) **The Value of the Term " Radical Cure," and the Permanence of the Cure after Operation.** Some years ago Mr. Macready, surgeon
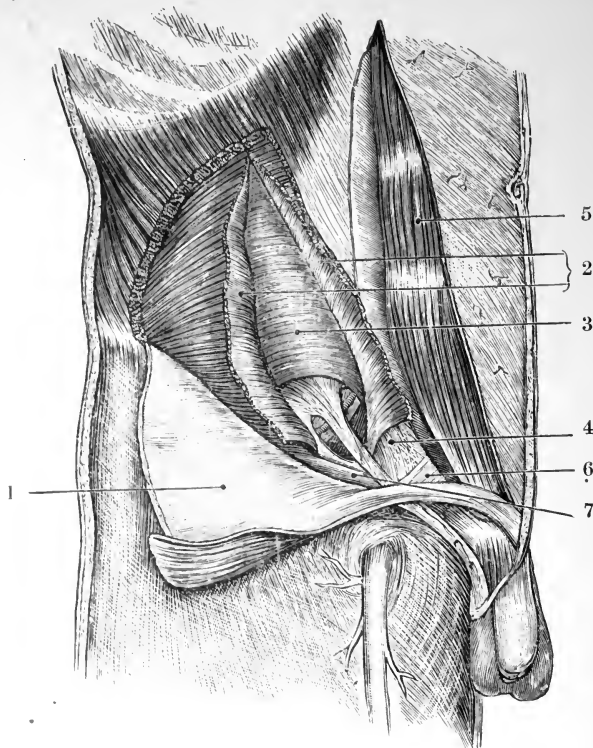

Fig. 16. Dissection of inguinal canal.

1, External oblique turned down. 2, Internal oblique. 3, Transversalis.
4, Conjoined tendon. 5, Rectus abdominis with its sheath opened.
6, Triangular fascia. 7, Cremaster. (Heath.)

to the City of London Truss Society, wrote the following weighty words on what he called the unsatisfactory nature of the evidence as to efficacy of the radical cure : [2] " The evidence brought forward by one surgeon after another in favour of these operations is always of the same character. A number of cases are given in which the operation has been performed, and in which the result has been watched for periods varying usually from a few months to four or five years. Very few cases are under observation so long as five years, for the patient changes his residence or declines to show himself. M. Terrier on one occasion wrote to twenty-five old patients, and received only two replies. It must not be supposed that a patient is cured because he does not come for inspection. The relapsed

[1] *Med. Rec.*, March 18, 1905.　　　　[2] *A Treatise on Ruptures*, p. 234.

cases at the Truss Society have almost all been asked if they have visited the operator to show him the result. In the great majority of cases they prefer not to go back, and very often, alas ! express themselves as if a deception had been practised upon them. It is much to be regretted that patients should feel this reluctance to face the operator again, for in consequence the surgeon is apt to form too favourable an opinion of the efficacy of his plan. Sometimes a patient, after remaining cured for a number of years, passes from under observation and again becomes ruptured. . . . All that we can say of the operations, involving complete removal of the sac, is that they all give immunity to a certain number for a certain time."

Since Macready wrote these melancholy words things have changed and improved greatly ; but some of his warnings are still to be remembered. Surgeons are still too apt to claim their results as radical cures after a few months or a year.

In recent years we have learnt more accurately the principles on which this operation is to be conducted. Two or three methods have now been employed on such a large scale, and with such excellent results, that it seems probable that a permanent cure can be promised in a large number of favourable cases. This qualified statement requires explanation. By a " permanent cure " I mean a cure which will last a lifetime. By " favourable cases " I mean children, young subjects, herniæ of moderate size, where the rings and canal are still present and not stretched and converted into one large direct gap into which the tips of two or three fingers can be easily placed ; cases where the patients operated on have sense enough to give the newly repaired structures sufficient rest for their consolidation, and where, if they must follow employment or exercise that involves much straining, they will give the parts the support of a truss of light pressure or a belt.[1] If this is not done we shall see, if cases are carefully followed up and candidly reported, that radical cures will not last a lifetime, and that the term will have to be largely replaced by the following, according to the degree of cure obtained, viz. " complete successes," " partial successes," " complete failures."

Since Bassini published, in 1888, the description of his operation this method, either as first described or modified in some slight degree, has become more and more popular, and at the present time its adoption may be said to be almost universal. Dr. Coley [2] published an account of 1000 operations for inguinal and femoral herniæ performed between 1891 and 1902 ; 937 of these were inguinal and 66 femoral. In 917 inguinal operations by the Bassini method there were only ten known relapses, or a little over 1 per cent. ; but these cases were not all traced for long enough time. Thus out of the total 1003 cases, 647 were traced and found well from six months to eleven years, 410 were well from two to eleven years. There were six relapses in 20 cases of inguinal hernia in which the cord was not transplanted. In 181 cases of inguinal hernia in women there were no relapses and no deaths ; the round ligament was

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[1] *Vide infra.* Many will say that if any truss or support is worn afterwards the cure is not *radical ;* I admit this, but reply that until published series of cases have been watched for a much longer period we shall, as relapses may occur five or eight years after operation, do wisely to advise the above class of patients to support the restored region with a well-fitting truss of light pressure, and so bring about a permanent cure instead of a liability to relapse.

[2] *Ann. of Surg.*, June 1903.

not transplanted in these. Coley gives statistics to prove that patients very rarely get recurrences after one year ; over 90 per cent. of the relapses appear in the first year.

It may be said, therefore, that after one year the chances of relapse are not great, although no absolute time limit can be given after which cure may be said to be absolute. Jonathan Hutchinson, jun.,[1] gives a very valuable and candid account of the results of his own cases at the London Hospital during the last fifteen years. Out of 360 operations for radical cure of inguinal hernia, he was able to trace 100 for over two years, the average being traced for six years. There were eight relapses— five pronounced, one very slight, and two doubtful relapses, having only a slight bulging at the site of the hernia. In five of the relapsed cases the sac had not been excised but only twisted and displaced, and the canal had not been sutured. In *only two of them had Bassini's method* been used, and Macewen's method in one case. It is interesting to note that seven of the 100 cases had developed some other hernia.

Bull and Coley [2] publish an account of 1076 operations on children after Bassini's method, with only six relapses, but mention five relapses in 125 operations performed about 1892 by other methods.

It is very striking to notice that in nearly all the relapsed cases some suppuration had occurred, and this is no doubt the main cause of the relapse ; a severe cough is another, especially if present during the first few weeks after the operation.

From the above it is clear that, when consulted as to the performance of a radical cure by patients the subject of hernia, they can be assured as to the safety of the operation and the probable permanence of the cure in favourable cases (*vide supra*). In the practice of experienced and aseptic surgeons the mortality ought not to be more than ·5 per cent., and the recurrences should be considerably under 5 per cent. Furthermore, it is certain that if a relapse should occur the majority of patients will be better off than before the operation. The protrusion that appears will be smaller than the original rupture, more readily kept within bounds like a bubonocele, and a truss will be worn with greater comfort. On the other hand, if *suppuration occur, and a thin-walled feeble cicatrix, sure to yield increasingly as years go on, is the only result*, the outcome of the operation may leave the patient worse off than he was before.

A question that often arises relates to **the wearing of a truss** and **the possibility of the hernia being cured by this means alone.**

The answer deciding between the wearing of a truss and an operation for radical cure will depend greatly on the mind of the surgeon consulted. If he is one of those who believe that this operation is too indiscriminately resorted to, he will hold that no operation, save for special reasons,[3] is to be advised where the hernia can be kept up by a truss, and that a light and well-fitting truss is not the bugbear it is too often made out to be by those who advocate operation as the rule. It would be well if surgeons would spend some of that pain and trouble in ensuring that the truss fits, before it is thrown aside, which they give to inventing or modifying operations for radical cure, and if patients would exert a little more trouble and pains in getting a proper and well-fitting truss at a duly qualified instrument-maker's, instead of the first cheap trash which they see in a chemist's shop. I have pointed out below, under the heading

[1] *Lancet*, 1906, vol. i, p. 903.   [2] *Med. Rec.*, April 18, 1905.
[3] *See* Indications for Operation.

Indications for Operation, the cases where this question of wearing a truss does not arise.[1]

A truss rarely cures a hernia in an adult, and, knowing this, most young patients naturally prefer an operation to the lifelong use of a truss.

When this question, whether the wearing of a truss will effect a radical cure, arises in the case of infants and children, these cases may be divided into the following groups : In one the careful wearing of a truss by a child will permanently cure the rupture. In a second group the hernia, though not cured, will be perfectly controlled with very slight inconvenience to the patient. In the third there is no tendency to spontaneous cure even when a suitable truss has been diligently worn. Very large herniæ, and especially those containing the cæcum, which may be irreducible, belong to this class. With the very small mortality of the present day and the few recurrences, surgeons attached to children's hospitals operate more and more frequently. It is very difficult to keep the children of the poor supplied with new trusses often enough to render them effectual. If the truss break or be left off and the hernia descend, the work of years is undone, and strangulation may occur at any time. Again, a number of patients supposed to have been cured by trusses in infancy have a return of their trouble in adolescence or early manhood.

Mr. Hamilton Russell [2] even believes that all the oblique inguinal herniæ of adults have descended into congenital sacs. We agree with Mr. Russell that a large majority of the so-called acquired herniæ of adults have congenital sacs of the incomplete or funicular type, but we still believe in the existence of acquired inguinal hernia.

Mr. Murray [3] adduces several arguments in support of Mr. Russell's views, and shows that in 100 autopsies potential hernial sacs were found in 21 cases ; 13 sacs occurred in 61 males, and 8 sacs in 39 females.

On this follows naturally the next question : (3) **What is the earliest age at which an operation should be performed ?**

Bull and Coley [4] operate on about one in ten of the children that come to their " service " seeking treatment for hernia, but they rarely operate without trying a truss for one or two years, and rarely under the age of four years. They advise operation in the worst of the cases over four. They also perform a radical cure in all cases of (1) strangulated hernia, and cases of strangulated hernia which have been reduced by taxis some days before ; (2) irreducible hernia, rare in children ; (3) hydrocele of a hernial sac ; (4) the rare cases of femoral hernia in children—they regard these as incurable by truss.

Stiles [5] gives the results of 360 operations for hernia in infants and young children, with five deaths and only four recurrences.

For the reasons given above surgeons now frequently operate ON POOR CHILDREN under the age of four, and with results at least as satisfactory as those obtained in older children and adults.

(4) **The Advisability or Need of wearing a Truss afterwards.** The tendency of the present day to condemn offhand or to deprecate strongly the use of a truss after an operation for radical cure is, I think, a great mistake. Each case must be judged separately. With regard to children, from an experience of my cases I think that if the recum-

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[1] An ill-fitting truss is, of course, worse than useless, and may mat together the tissues.
[2] *Lancet*, vol. i, 1905, p. 7.   [3] *Ibid.* vol. i, 1906, p. 363.
[4] *Med. Rec.*, March 18, 1905.   [5] *Brit. Med. Journ.*, October 1, 1904.

bent position be insisted on for three weeks after the operation, so as to give the newly restored parts time to consolidate firmly, a truss will not be subsequently required, so great is the tendency to repair in early life. Umbilical herniæ I am inclined to make an exception.· The communication which has here been closed has been relatively so large, the stress thrown upon it after repair in expiratory efforts (as when the child cries every time at the approach of the surgeon or dresser during the after-treatment) is so direct, that the scar should, I think, have support for some time in the form of a well-fitting belt.[1]

In adults the objection usually made to a truss is that its pressure will produce absorption of the scar. While it will be granted at once that any continuous pressure in the form of a pad with a strong spring will tend to weaken and remove the inflammatory thickening resulting from the operation, I am distinctly of opinion that some well-fitting slight support in the form of a flat-bladed truss or belt should be worn in the following cases, viz. where the abdominal walls are very fat, flabby, and pendulous ; where there is heavy work either done continuously or by fits and starts ; where there is a chronic cough ; in some cases where the radical cure has been done after an operation for the relief of strangulation, and the surgeon has perhaps been hurried ; and, of course, in cases where there is any return of the hernia. Other cases are umbilical herniæ, both in adults and children, for the reason I have given above ; in some cases of femoral hernia in which the crural ring has been very large and difficult to close in stout patients ; moreover the sex and dress of the patient usually make the wearing of a truss less irksome. On the other hand, in early congenital cases, in boys, in young adults without laborious work, or where the reparative power is good, where sufficient rest has been taken after the operation, and where primary union has been secured and remains firm, no truss need be worn. But the importance of intelligent supervision at intervals should be insisted upon.

Lockwood does not order a truss after operation, except in cases in which some support is specially called for. He says : " So far as I can see, it is time enough to order a truss when signs of recurrence appear. After radical cure has been done relapse seldom occurs suddenly. When the sac has been thoroughly obliterated by the operation, the hernial protrusion has to make for itself a new one ; this is usually a slow process and accompanied by pain from the beginning." This practice is clearly justified by results, for Lockwood's list of cases shows only five relapses in ninety-one cases, in periods varying from six months to seven years. It may be noted, also, that in each of these five cases the relapse occurred within twelve months.

(5) **The Best Form of Suture.** Surgeons still hold different views upon this point. The ideal suture should be aseptic, absorbable, supple, and strong. At the present time it is easy to get catgut fulfilling all these requirements. I always use tanned catgut directly it is removed from sealed glass tubes. Silk is most satisfactory to work with at the time ; it can be obtained at once, it is soon sterilised, it is strong, and it lends itself readily to easy tying and a secure knot. But the after-result is, in my opinion, less satisfactory, owing to its liability to come away. There is a tendency to believe and teach that wherever silk comes away after an operation it must always be due to some deficient sterilisa-

[1] Any phimosis or cough should, of course, be treated.

tion of the silk, or to some failure to keep the wound aseptic. While these are leading causes, they are not, I am persuaded, the only ones ; the site and the character of the tissues concerned play a very important part. Inside the peritoneal cavity, where the ligature lies deep and is surrounded by a serous membrane, as in an ovarian pedicle, we are certain our silk ligature will give no trouble ; in ligature of the carotid or femoral artery, where the ligature also lies deep and is surrounded by vascular structures, we never have trouble with our silk ligatures ; but here, where any silk used lies comparatively superficially and embedded in fibrous tissues such as the conjoined tendon or Poupart's ligament, its surroundings are so different that a surgeon need not always blame himself for deficient asepsis when his silk comes away. In a certain and large proportion I know from experience that silk can be used, but in a considerable number this and other unabsorbable materials most certainly cause trouble later on. The wound runs an aseptic course, heals without suppuration, and then, after a varying period, up to several years sometimes, a sinus appears, and one or more of the sutures have to be removed. Drs. Bull and Coley, in the cases referred to above, used kangaroo-tendon chromicised enough to resist absorption for from four to six weeks, and though the interval between the date of operation and that of publication is in many of them far too brief for the cure to deserve, in my opinion, the term "radical," the constancy with which primary union was secured speaks very strongly, I think, for the use of kangaroo-tendon in preference to silk. Catgut can also be prepared in a similar way and is certainly preferable to silk. Hutchinson [1] also strongly recommends kangaroo-tendon because it is strong, supple, and non-irritating, and can be kept for years without deterioration in an alcoholic solution of carbolic acid.

Professor Macewen in his address on Surgery at Oxford [2] discusses the advantages and disadvantages of the various suture materials very fully. He points out that it is not enough to secure an aseptic ligature, but that it is necessary to select one that is absorbed after its work is done in about three weeks. He also draws attention to the important fact that non-absorbable sutures are incapable of *holding living structures together for more* than a few weeks. "After a period of twenty-one days the continued traction of the suture causes the soft tissues to give way before it. And this goes on until the suture lies loose and functionless in their midst." The tissues within the grip of permanent sutures of silk, wire, or salmon-gut become gradually absorbed even without any suppuration, and this clearly leaves the sutured area much weaker than after the use of an absorbable suture like catgut, which does not induce nearly so much of this quiet and aseptic necrosis of the tissues if care be taken not to tie it too tightly.

Macewen strongly condemns the use of wire sutures, and relates five cases of inguinal hernia in which gold wire had been employed by other surgeons. Three of these came to Macewen for recurrence of the hernia, and the two others for strangulation of the bowel by the loops of wire. In one of these perforation of the bowel had already occurred at the site of constriction by the wire.

Macewen states that kangaroo-tendon does not get absorbed for months, and Hutchinson has found some of his sutures unabsorbed after over two years.

[1] *Loc. supra cit.*   [2] *Lancet,* August 6, 1904.

Macewen prefers catgut to all other materials for sutures, and the following remarks are quoted from his address :

" Catgut is one of the best substances generally available for sutures and ligatures, but care ought to be exercised in choosing good material. For ligatures and sutures raw catgut ought to be selected, preference being given to such specimens as present the best physical properties and show that care has been bestowed on its manufacture. It must be evident that the subsequent preparation does not remedy physical defects originally in the gut, such as want of strength or roughness. When the catgut is selected it is then placed in a solution prepared for the purpose of increasing the resistance offered by the gut to the action of the living tissues. As the resistance required varies according to the use to which the catgut is to be put, so the catgut is prepared with various degrees of resisting power, some hanks for rapid absorption and some capable of resisting the action of the tissues for longer periods. The gut must not be hardened in such a manner as to prevent leucocytal penetration, otherwise it will be too resistant, and in this way may be no better than silk or wire. Experiments have been made in many directions with the view of obtaining a suitable medium for the preparation of catgut so as to obtain the objects in view. One of the best media which we have used is obtained by adding an aqueous solution of chromic acid to glycerine in definite proportions. This compound is found to act upon the catgut in the way of increasing its resistance to the action of the living tissue. Though producing a soft, pliable catgut, the degree of resistance imparted to the gut can be varied according to the time during which the gut is immersed in the solution. The longer it is kept in the solution the more resistant it becomes. After it has thus been prepared it is stored in a carbolised glycerine solution. It is ready for use a fortnight after it has been introduced into the storage solution. When kept in this storage solution for a longer period—many months or several years—it becomes slightly more resistant to the tissues."

WOUND HEALING

The mortality and the relapses after radical cure of hernia depend more upon the occurrence of suppuration than upon anything else ; therefore it is of the utmost importance to prevent the slightest suppuration.

With modern precautions in sterilising swabs, instruments, and sutures, the most frequent sources of infection are :

(1) **The Hands of the Surgeon** and of his assistants ; the risk of infection from these has been greatly diminished by the general use of boiled rubber gloves by all concerned. It must not be forgotten, however, that the gloves may be easily contaminated in putting them on or by touching the patient's skin. The hands must be cleansed as thoroughly as possible before putting the gloves on, for the latter may be accidentally pricked during the operation and the wound thus infected from the operator's hand.

Bull and Coley [1] had 4·4 per cent. of suppurations in 567 early cases before the use of rubber gloves, and only 2·1 per cent. in 933 later operations. This difference is no doubt partly due to the increased experience of the two operators, and also to improvements in their tech-

[1] *Loc. supra cit.*

nique in other respects, such as reducing laceration and bruising of the tissues to a minimum.

(2) **The Patient's Skin.** That this risk is considerable, even with much care in scrubbing and compressing, is evident from the following facts (Bull and Coley [1]) :

" A careful bacteriological examination of some fragments of skin taken from the field of operation just prior to the making of the incision was made by Dr. M. Jeffries in 290 cases, with the following results :

Total number of skin cultures	290
Number of instances in which growth was obtained	27
Per cent. not sterile	9·31
Streptococcus obtained	7 times
,, ,, ...	2·41 per cent.
,, ,, alone	4 times
,, and a diplococcus	2
,, ,, ,, tetrad	1
Micrococcus tetragenous	10
A diplococcus	6
Tetrad and bacillus	1
Bacillus alone	2
Staphylococcus and a bacillus	1."

Cleaning the skin with acetone or ether and then painting with iodine is considerably more effective in sterilising the skin.

This source of infection can be minimised by fixing aseptic pieces of lint to the very edges of the wound, so that none of the patient's skin is exposed, and sutures, sponges, or gloved fingers cannot convey any infective scales from it into the wound.

If the above precautions be taken, and all bruising be avoided, and all hæmorrhage arrested, the risk of infection becomes very small.

Indications. The following are given only as types of appropriate cases. Many others will suggest themselves :

(i) Cases of *irreducible hernia* where other treatment has failed, where an active life is interfered with, or where attacks of inflammation have occurred or strangulation is threatened. Subjects of inguinal hernia with adherent omentum are never really safe, especially if of active life : from this, however, they are usually debarred. Femoral herniæ containing irreducible omentum should also be operated on. These herniæ are difficult to fit with trusses ; the omentum keeps the ring open, and thus paves the way for the descent of bowel on any sudden exertion. Where irreducible herniæ are small, and the adhesions easily separated, great relief will be given the patient with very slight risk. But it is otherwise where the sac is very large, or the contents adherent, especially about the neck of the sac. In either case the risk of the operation is increased. Intricate adhesions about the neck of the sac may either lead the surgeon to abandon the operation, or to lay open the abdominal wall in order to deal with them. This last step may bring about, some time later, a hernia very difficult of control, the ultimate improvement in the patient's condition being thus of a very limited nature.

(ii) Cases of *strangulated hernia*, where the patient's condition admits of the operation being prolonged.

[1] *Med. Rec.*, March 18, 1905.

(iii) Cases where a *hernia is not controlled by a truss*, but slips beneath it. Such cases would be extremely rare if patient and surgeon alike showed sufficient pains and patience in securing a well-fitting truss.

(iv) Cases of hernia *with ectopia testis* where the fitting of a truss to keep the hernia up and the testicle down fails. Castration should always be performed when the condition of the testis is hopeless.

(v) Cases where the *hernia can be controlled by a truss, but the use of this is irksome* to a patient of active life, where he wishes to join the army or navy, or where he may, as a colonist, be far removed from surgical help.

(vi) *Children of poor*, ignorant, and incompetent parents, with large herniæ, where proper attention to the use of a truss cannot be secured, or where the persevering use of this has failed, and where all such causes as phimosis, cough, &c., have been removed. It will probably be justifiable to go further than this, and to operate for radical cure in most cases of herniæ in the children of the poor in which the hernia is still large at three to four years of age.[1] By this time the parts are better developed and more easily kept aseptic. The sac is more easily dealt with now than later. The presence of any conditions which call for exploration, viz. hydrocele, adherent omentum, the presence of the appendix, will also be indications for operation in children. On this point, operation for radical cure in little children, I will quote Mr. Macready.[2] We may all envy his special experience and strive to imitate his skill. "Uncontrollable ruptures in children under fifteen are very rare; to me, indeed, they are as yet unknown. I hope it does not imply any lack of charity to say that one can measure with fair accuracy a surgeon's skill in the management of trusses by the number of curative operations he performs on children." But a truss is irksome and interferes with healthy exercise and games, and it rarely *cures* a hernia after infancy. On the other hand, there is very little risk in an operation at the present day. Recurrences after it are rare in children, and the relief afforded by it is immediate and nearly always final.

(vii) Large herniæ, even colossal, where the patients, unfitted for work of any kind, are a burden to themselves and others,[3] and perhaps willing to run great risks; for it cannot be denied that these are grave cases: "the operation usually difficult and prolonged, and the dangers to be met and overcome both numerous and various" (Banks). The chief of these is the direct and gaping communication with the peritoneal cavity and the difficulty in keeping the operation extra-peritoneal.

(viii) I consider four to thirty years of age the most favourable time, as combining parts easy to handle, and the probable absence of any difficult adhesions, and good vitality and health. Old age, in the absence of visceral disease or degeneration of the abdominal wall, and apart from the natural expectation of life, is not a contraindication.

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[1] This age is mentioned above as giving time for sufficient trials with a truss.
[2] *Loc. supra cit.*, p. 256.
[3] As in three cases given by Sir W. M. Banks: one, a labourer, unfitted for work, had become an inmate of a workhouse; the second was a wine merchant, who had been obliged to give up his business, rarely venturing out, and then obliged to conceal his deformity under a large overcoat; the third, a glass-blower, reduced to perfect helplessness, had to depend on his wife for his support.

OPERATIONS FOR INGUINAL HERNIA

Before describing the different methods mostly in vogue, I will allude, for the sake of my younger readers, to a few points which are always of importance, whichever method is selected.

The thigh being a little flexed, an ample incision is made over the inguinal canal, and extending an inch below the external abdominal ring. This divides skin and fasciæ, the superficial epigastric, and several branches of the external pudic vessels ; these should be secured with forceps, which will also open out the wound. In young males, especially where these vessels are of considerable size, care must be taken that each
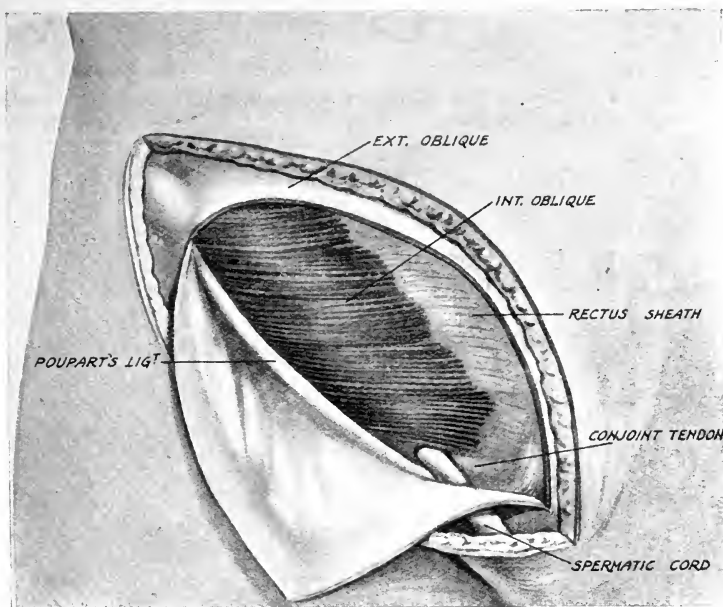
Fig. 17. Normal inguinal canal. The deep muscles closely enwrap the cord and make the canal long and valvular.

point is firmly closed either by the forci-pressure or catgut ligature ; otherwise free bleeding may readily take place in the lax tissues of the groin, preventing primary union. The aponeurosis of the external oblique and the cremasteric fascia having been next divided, the site of the cord is made certain of, and the sac most carefully defined. This, if empty, is by no means always easy, especially in young subjects. In defining the sac care should be taken to work carefully and without any needless disturbance of the parts, or separation of the planes of tissue here met with. So, too, with the cord—great care must be taken in the next step, when the sac and this structure are separated ; hasty work may lead to needless hæmorrhage from ruptured veins, injury to the sac, or subsequent epididymo-orchitis. The sac, having been accurately defined, is opened so that the operator may make sure that it is empty ; otherwise any intestine is completely reduced or omentum dealt with according to the steps given at p. 20. If the

question arise, whether the sac should always be opened, I should answer "Yes." Even if it appear empty below, it is satisfactory to be assured by visual examination that nothing lies within the neck before this is twisted or tied as high up as possible. A case of Busch's [1] shows the importance of taking this step.

Operating on a boy 2½ years old for a right inguinal hernia, Busch tied the sac before opening it. When it was cut into below the ligature the vermiform appendix was found included. This was released and returned. Some time later Busch was operating on the left side, and again found that he had included the appendix in his ligature round the sac.

Herniæ with Unusual Contents. These may be: (*a*) *Fat Herniæ.* Both in the inguinal and femoral regions, but especially in the latter, the extra-peritoneal tissue near the rings may become increasingly fatty. Gradually projecting towards the surface, it drags down the peritoneum, to which it is loosely connected. I have operated on one such case in a girl, aged 19, in whom the fitting of a truss was unsatisfactory. Here I expected to find an omental hernia. Into the pouch so formed intestine or omentum may protrude. In other cases, if the extra-peritoneal fat thus protruded become absorbed, the hollow thus left may produce a space for the peritoneum to project into. (β) *Hernia of the ovary.* This is much more commonly met with in inguinal herniæ. The chief points in the diagnosis of these difficult cases are the characteristic oval shape and size of the swelling; the peculiar sickening pain when the swelling is pressed upon; the swelling being larger and the tenderness greater during menstruation. Where other treatment has failed, where the swelling is irreducible and prevents the fitting of a truss, the displaced ovary should be replaced or removed. Adhesions are not uncommon. (γ) *Hernia of vermiform appendix.*

I met with a case of this early in 1890, in a lady, aged 43, a patient of Dr. Fraser, of Romford. The femoral hernia was here irreducible, dull, gave a feel of omentum, and curved upwards and outwards in the usual way. As no truss was satisfactory, and as the patient, the wife of a missionary, was to be much abroad, a radical cure was advised. The sac contained much fluid, but no omentum. In the outer part of the hernia lay a thick fleshy body, tubular and expanded at its end. Near Gimbernat's ligament it was constricted and distinctly abraded. After notching the above ligament this body, which proved to be the appendix, was easily returned. The sac was removed. The case did excellently.

In later cases I have always removed the appendix. (δ) *Hernia of the bladder.* The viscus may descend either partly or completely covered by peritoneum; in the first and commonest form the bladder may not be recognised until it is wounded, or even until collapse develops, and hæmaturia is discovered some hours later. I know of two cases in which this accident occurred during the radical cure of femoral hernia, and one of the patients died. The bladder protrudes more frequently into an inguinal hernia.

When the emptied sac is next separated from the cord and adjacent parts, beginning high up near the internal ring, where the vessels are few and close together. Care must be taken, if the patient strain at this time, that no escape of intestine occur, an assistant maintaining pressure over the internal ring. The cord must be treated with the precautions given above, and care must be taken that the testicle is not dragged needlessly out of its bed. The sac is now treated, and the canal closed by

[1] *Klin. Med. Woch.*, 1882, No. 31, p. 473.

one of the methods given in detail below. The wound having been thoroughly dried out, it is closed with sutures of salmon-gut, care being taken that no inversion of the edges is present, and, of far more importance, that all hæmorrhage has been entirely stopped, including those points from which pressure-forceps have been removed. Sterilised dressings are applied. In applying the bandages it is important to keep the scrotum well up on the pubes, and thus to minimise the risks of œdema of the scrotum and epididymo-orchitis.

To the above general remarks I have only to add that it is always
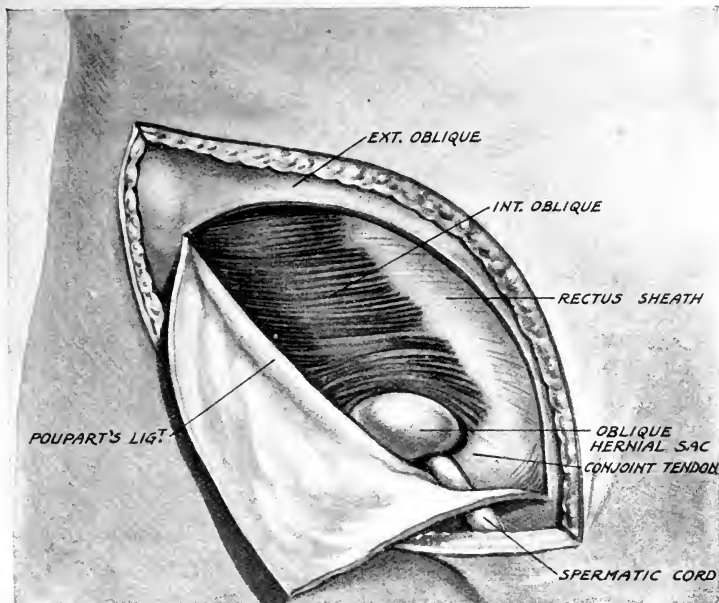
FIG. 18.   Inguinal canal in hernia. The sac displaces the deep muscles and makes the canal more direct and less valvular.

well, when the radical cure is performed in patients with long-standing hernia (with important parts and the sac perhaps very adherent), or a voluminous one, for the operator to obtain leave beforehand to sacrifice the testicle ; and the same course will be taken when a retained testicle is found to be probably functionless. If it is worth while to fix this again in the scrotum, this should be done according to the steps given under the heading of Orchidopexy.

Choice of Operation. The different methods that have been elaborated are very numerous, and only those which are chiefly in vogue at the present time can be described here in full. Brief mention will, however, be made of some of the others.

(1) **Bassini's Operation** (Fig. 19). An oblique incision, at least four inches long in an adult, somewhat less in a child, is made over the position of the inguinal canal, and ending below opposite the pubic crest. The fasciæ having been divided, the external oblique aponeurosis is exposed and the external abdominal ring identified. The external

oblique is now divided along the length of the canal, and flaps separated in both directions for a short distance, thus thoroughly exposing the whole length of the inguinal canal. In small herniæ it is not necessary to carry the incision in the external oblique into the external ring, and as this is difficult to re-form accurately the ring is best saved in these cases. The cremasteric fascia and the thin infundibuliform fascia are then divided along the upper border of the cord. The sac is now identified and
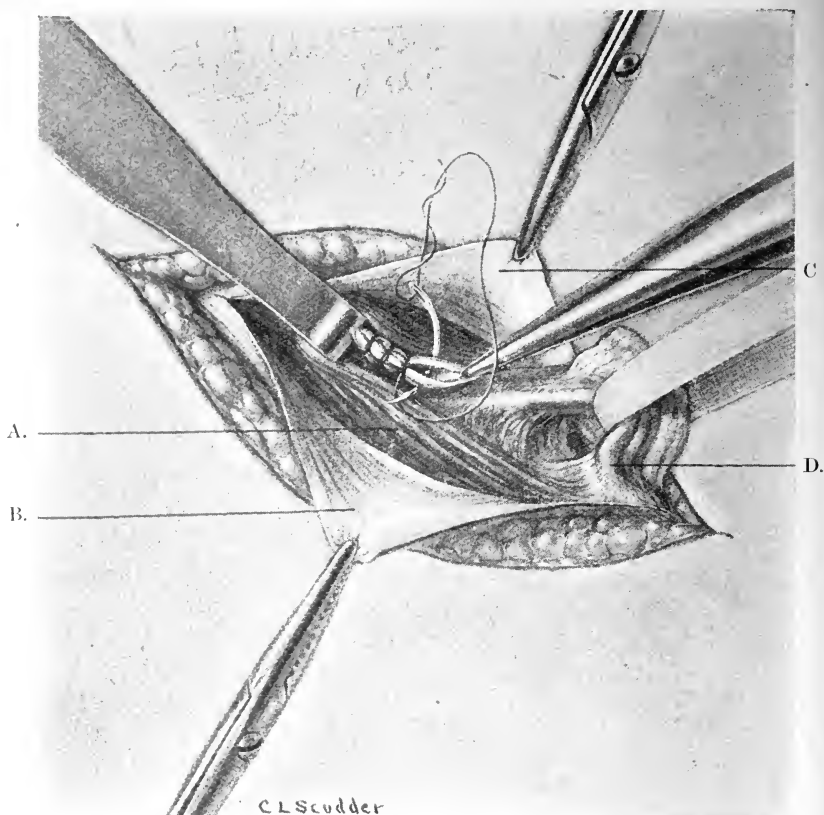

FIG. 19. Scudder's modification of Bassini's operation. Sewing the neck of the sac, a retractor being used to expose it well. (*Ann. of Surg.*)

A. Large cremaster. B, External oblique. C, External oblique. D, Vas deferens.

carefully separated from the cord well up to and an inch above the level of the internal ring. The separation is bloodlessly and rapidly effected by " gauze dissection," beginning just below the internal ring. It is then opened and emptied, all adhesions being carefully separated and any adherent omentum ligatured and removed. The neck of the sac, having been somewhat pulled down, is transfixed and ligatured at the highest possible point, then divided well below the ligature, and the rest of the sac removed. Next, the cord is separated from its bed, and, supported in the loop of a Lane tissue-forceps, is held forward by an assistant while the sutures are introduced. At this stage any lipomata of the cord or an

inguinal varicocele may be removed.   The posterior wall of the inguinal canal is now repaired by means of sutures.   These will vary in number from four to six, according to the size of the gap between the internal oblique or conjoined tendon on the one hand, and Poupart's ligament on the other.   The needle is first passed through the deep aspect of Poupart's ligament, then back and fore through the cremaster, and finally through the lower margin of the internal oblique or conjoined tendon beneath the
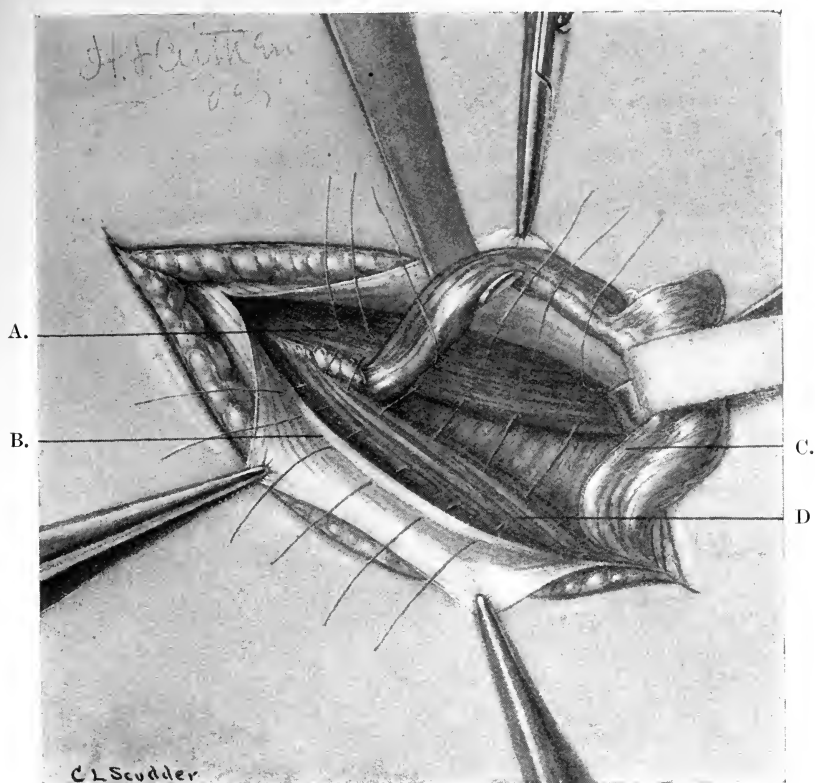

FIG. 20.   Scudder's modification of Bassini's operation.   Note method of passing sutures, especially those above and external to the cord.   (*Ann. of Surg.*)
A, Internal oblique.   B, Poupart's ligament.   C, Cord.   D, Cremaster.

uplifted cord (Figs. 20, 21).   Sufficient sutures having been passed, they are tied carefully and cut short, and the cord allowed to fall back into its place.   The divided edges of the external oblique are now united by means of a fine continuous suture, and the external ring, if large, diminished at the same time.   All bleeding having been carefully arrested, the skin is sutured with fishing-gut and the dressings applied.

Scudder [1] modifies Bassini's operation in several respects :

(*a*) He *sutures* the peritoneum *above* the neck of the sac, instead of ligaturing it (*see* Fig. 19).

(*b*) He also places a couple of sutures above and outside the cord to

[1] *Ann. of Surg.*, vol. xli, 1905, p. 76.

strengthen the attachment of the internal oblique to Poupart's ligament. Bull and Coley also use this improvement to prevent recurrence at this likely spot (see Fig. 21).

(c) Scudder's method of deep suturing is more effective than Bassini's (see Fig. 20).

(d) He also overlaps the fibres of the external oblique. I practise and recommend these modifications except the first, which I only employ for sacs with wide necks.
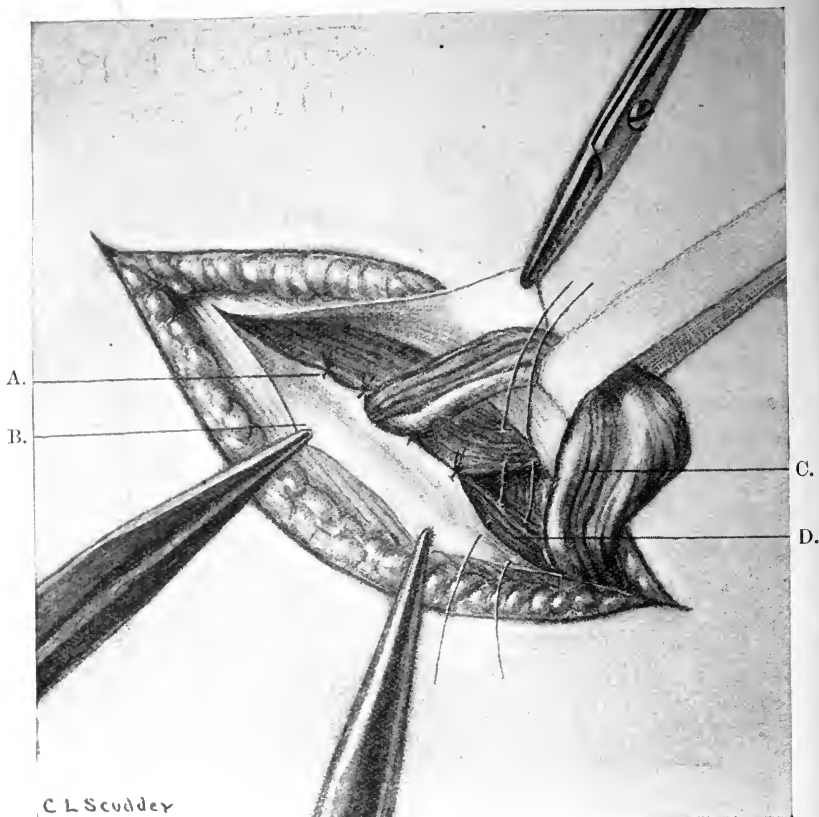

C L Scudder

FIG. 21.   Scudder's modification of Bassini's operation.   Sutures above and below the cord tied except two.   (*Ann. of Surg.*)
A, Poupart's ligament. B, External oblique. C, Cord. D, Cremaster.

(2) **Kocher's Operations.**[1] Professor Kocher has wisely abandoned his earlier method of treating the sac by torsion, and drawing it out through the external oblique aponeurosis and fixing it as a buttress along the anterior wall of the inguinal canal ; the sac often necrosed after being treated in this way.

Kocher now uses two simpler and safer methods of dealing with the neck of the sac.

The external oblique aponeurosis, the external ring, and the sac are exposed, *but the external oblique is not incised.* The sac is completely

[1] Kocher, *Operative Surgery*, p. 192.
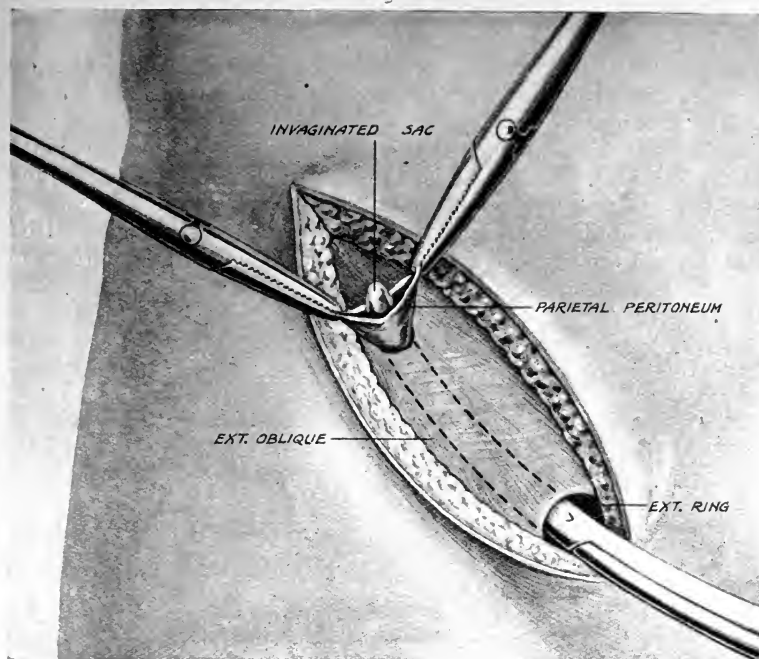
FIG. 22.   Kocher's method of invaginating the sac and bringing it out through the abdominal muscles.   (Kocher.)
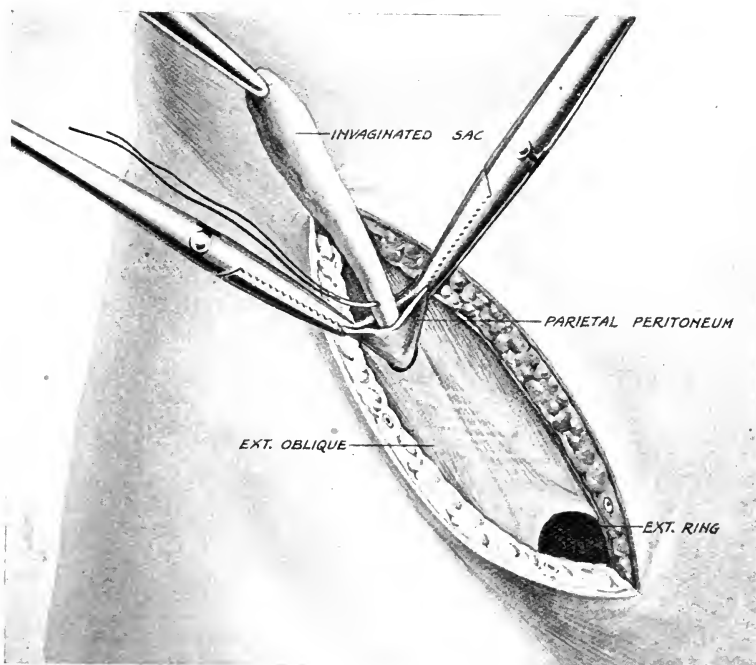

FIG. 23.   Kocher's method of invaginating the sac, and securing the neck to the parietal peritoneum.   (Kocher.)

isolated and emptied. " The next step depends on whether or no the sac can be easily invaginated into itself from below.   In the former case [1] the sac is treated by transposition and invagination; in the latter [2] by simple transposition."

A. *Transposition by Invagination*.   The Transposition-Invagination Method (*see* Figs. 22 to 24) is the most effective.   The fundus of the sac is grasped by a pair of curved narrow dressing-forceps (with toothed ends similar to Kocher's artery-forceps) and invaginated backwards through the inguinal canal, keeping the points of the forceps close
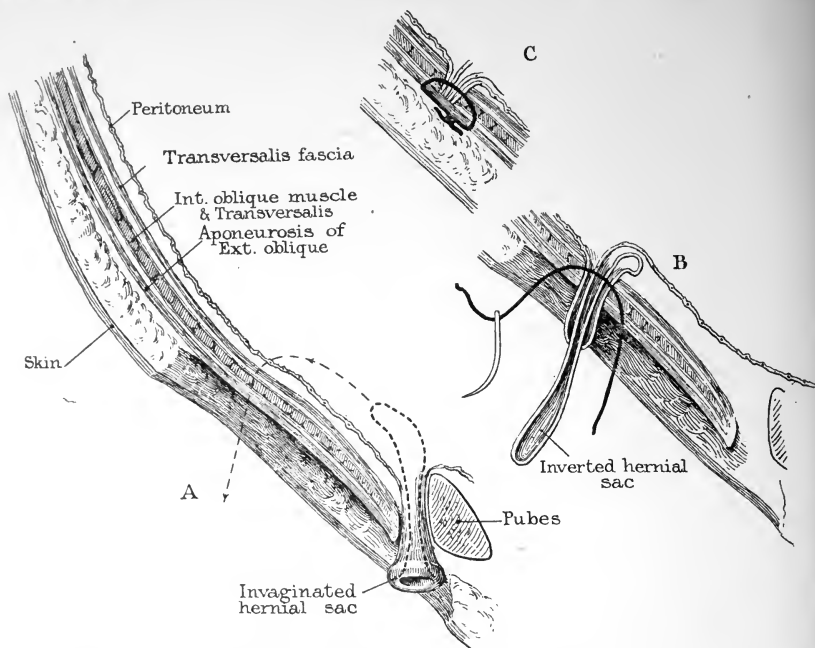
FIG. 24.   Sections to illustrate Kocher's method of treating the sac by invagination.

behind the anterior wall until they reach the internal abdominal ring, where they are caused to project forwards. [3]

A small incision is made through the external oblique aponeurosis at this point and the nose of the forceps pushed through, covered by the parietal peritoneum, which is then incised, the edges being caught in artery-forceps.   The apex of the sac is now seized with artery-forceps and the curved dressing-forceps are loosened and withdrawn from the canal.   The whole length of the inverted sac, the serous surface of which is turned outwards, is forcibly drawn up (Fig. 24), its neck transfixed, and firmly ligatured at the opening in the aponeurosis and divided, the stump being allowed to slip back.   The small opening in the parietal

[1] In an ordinary uncomplicated adult hernia this is practically always possible.

[2] In children invagination is often difficult, as the sac is sometimes very short and thin.

[3] The most common mistake is that the forceps are not kept close enough to the anterior wall of the canal, and that they are pushed too high up towards the anterior superior spine of the ilium.   It is only by a gross mistake of this sort that it is possible to injure the intestine or to nip it between the invaginated sac and the parietal peritoneum.

peritoneum and in the aponeurosis is then closed with a stitch and the canal sutured (*vide infra*).

B. *Lateral Transposition.* When the sac cannot be invaginated either from its shortness, tension, or thinness, or because it is advisable to remove it entirely, the apex of the sac is simply grasped with curved forceps and pushed up the inguinal canal immediately behind its anterior wall as far as the internal abdominal ring, where, as described above, it is protruded through a small opening in the aponeurosis and forcibly pulled out (Fig. 25).

As the sac has not been invaginated the parietal peritoneum in this
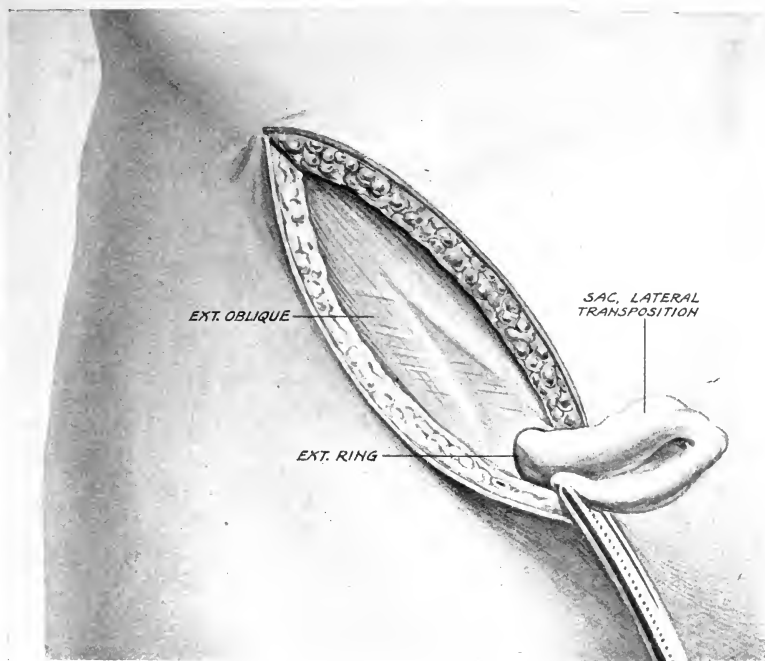
FIG. 25.   Kocher's lateral transposition of the sac.   (Kocher.)

case is not opened.   The neck of the sac is ligatured with strong thread close to the slit in the aponeurosis, the sac itself is cut off, and the stump allowed to retract inside the abdomen.   The small opening in the aponeurosis is then closed, and finally the canal is sutured.

Narrowing the Canal. The inguinal canal is closed in the following manner : "A series of interrupted sutures is introduced beneath the aponeurosis of the external oblique where it forms the anterior wall of the inguinal canal, and the portion thus in the grasp of the suture is then depressed with the finger, so that when the sutures are tied two parallel folds are approximated.   Two to four sutures are then inserted so as to bring together the pillars of the ring, care being taken that when they are tied the circulation in the cord is not interfered with " (Fig. 26).

Professor Kocher claims 97·7 per cent cures in 173 operations by the invagination method, and 95·5 per cent. in 508 operations by the lateral transposition method.   All the cases were observed for five years.

" At autopsies performed at longer or shorter intervals after the operation we have had the opportunity of seeing the results of this procedure. On the peritoneal aspect at the spot where the sac was drawn through, a fine circular peritoneal cicatrix is seen as a prominence with two shallow recesses above and below it. The parietal peritoneum on the mesial aspect is raised in slight folds about 2 to 3 mm. in height. There is no sign of any invagination into the inguinal canal."

However perfectly the funnel at the neck of the sac may be obliterated by Kocher's method, we do not like his way of narrowing the inguinal canal, for the cord is not dislocated outwards. or the inguinal canal made
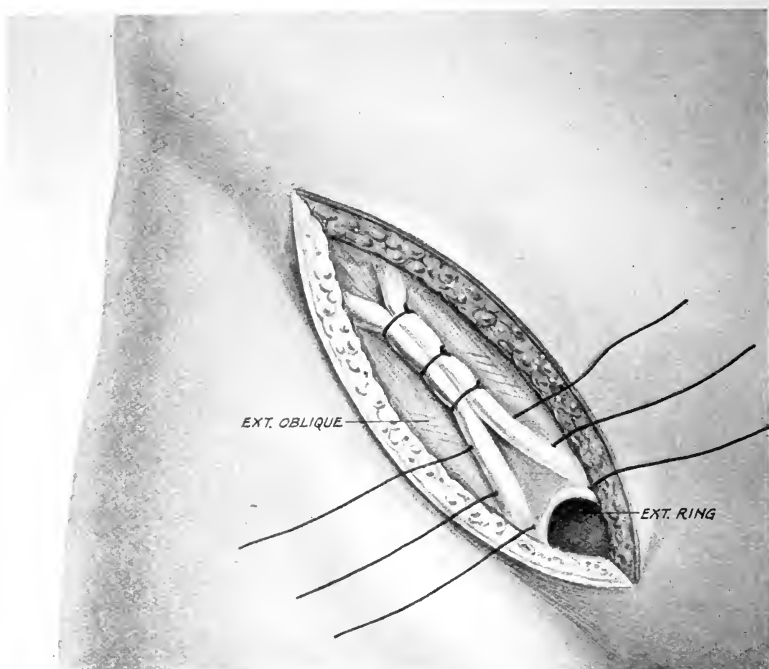
Fig. 26. Kocher's method of narrowing the inguinal canal. (Kocher.)

more oblique and valvular. We prefer to open the canal to obtain a good view of the parts to be sewn together. We also like to open the sac to make sure that its neck is empty and free of omental adhesions. In women and girls it has been shown that transposition of the comparatively small round ligament is not essential, therefore Kocher's method may be found useful in them ; and in some cases of strangulated hernia, where time may be precious, this rapid way of performing a radical cure may be employed with advantage.

Kocher's treatment of the sac is not so simple as the high ligation or suture which can be practised when the canal is opened. The thin sacs of children and of some adults cannot be treated by invagination without considerable risk of laceration of the neck.

Very thick inelastic sacs and those with adherent contents are also unsuitable for this operation.

(3) **Halstead's Operation.**[1] Halstead's original operation has been very much modified by Halstead and Bloodgood. The inguinal canal is opened as in Bassini's operation and the cremasteric fascia and muscle are then incised along the superior border of the spermatic cord. The internal oblique muscle and the conjoined tendon of this and the transversalis muscle are thoroughly exposed and defined. The spermatic veins, if enlarged as usual, are excised, care being taken to avoid any extravasation of blood into the loose areolar tissues around
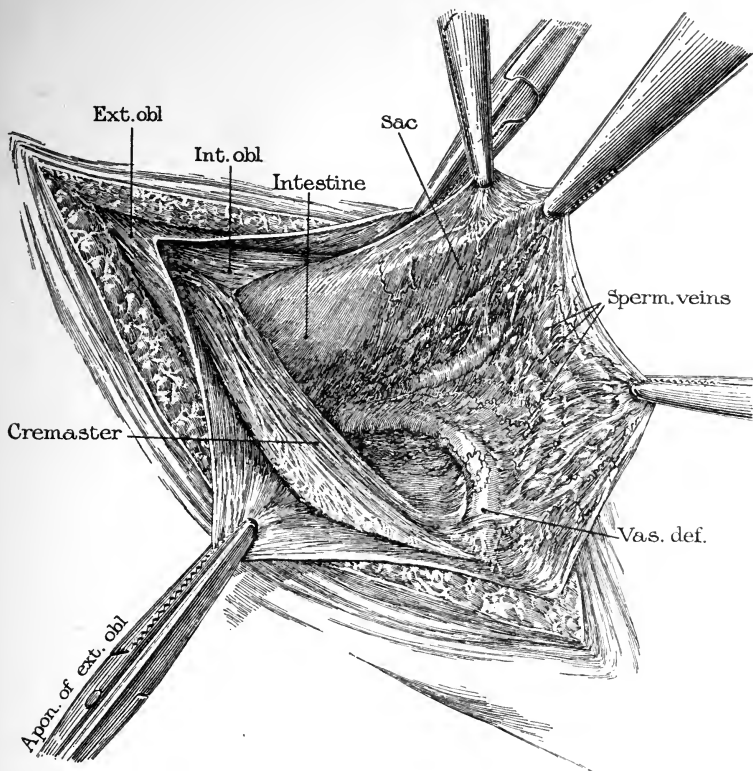
FIG. 27. Halstead's operation. Before the veins and fat have been excised.

the vas deferens, and the small veins which accompany it. The vas is not touched or moved lest thrombosis of its veins occur.

The spermatic veins are pulled down, transfixed, and tied as high up as possible; another ligature is similarly applied to these veins just below the external ring, and the intervening bundle is excised, leaving no large veins in the canal, which can therefore be almost completely obliterated by the following steps :

The neck of the sac is transfixed and tied as high up as possible, and the ends of the ligature are threaded on long curved needles which are passed deep to the arching fibres of the internal oblique and transversalis, to pierce these muscles at two points one-eighth of an inch apart well above and outside the internal abdominal ring. The

ligatures are tied ; they serve to displace the neck of the sac outwards, and any funnel that may remain above the ligature.[1]

The lower flap of cremasteric fascia and muscle is now drawn up deep to the internal oblique and the conjoined tendon, and fixed there by fine interrupted sutures (see Fig. 28, I).

The internal oblique muscle and the conjoined tendon are then joined to the deep surface of Poupart's ligament by means of stouter interrupted sutures (see Fig. 29, II).
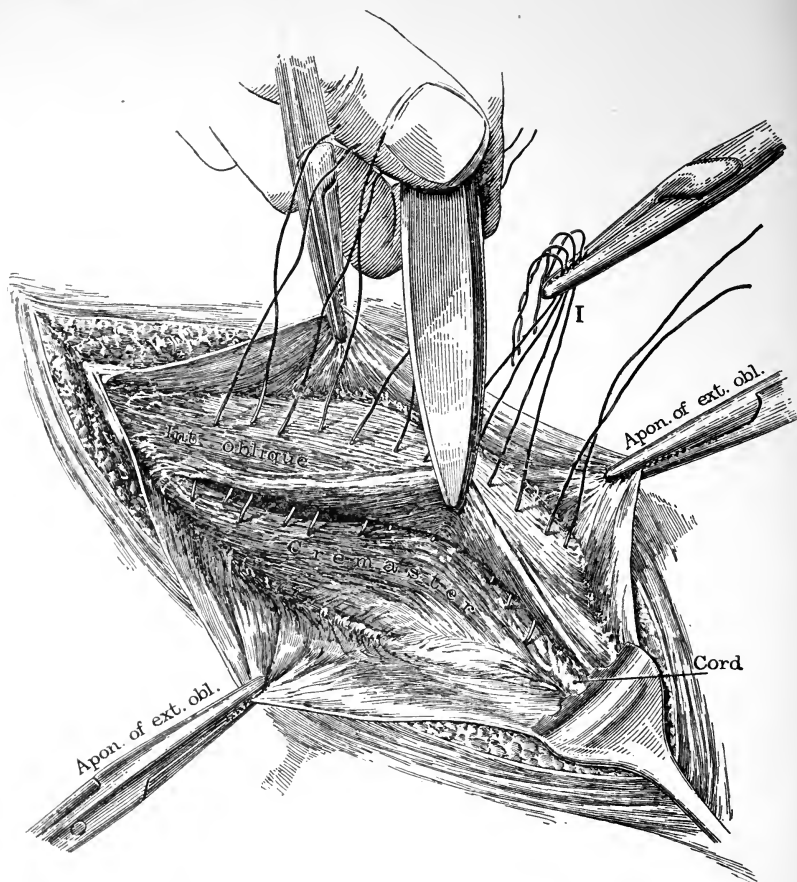

FIG. 28.   Halstead's operation.   Sewing the cremaster deep to the internal oblique.

If necessary the rectus sheath may be incised vertically in order to allow the lower sutures to be tied without undue tension.

This is found very useful when the conjoined tendon is narrow and atrophied.   The wound in the external oblique aponeurosis is closed by the Andrews-Halsted overlapping method (see Figs. 30 to 32).

If the hernial orifice is very large a flap of the anterior wall of the rectus sheath may be reflected downwards and outwards and sewn to the deep surface of Poupart's ligament (see Fig. 33) ; or the outer

[1] See Kocher's lateral transposition method.

margin of the rectus sheath may be slit up to liberate the rectus muscle, which may then be sutured to Poupart's ligament.[1]
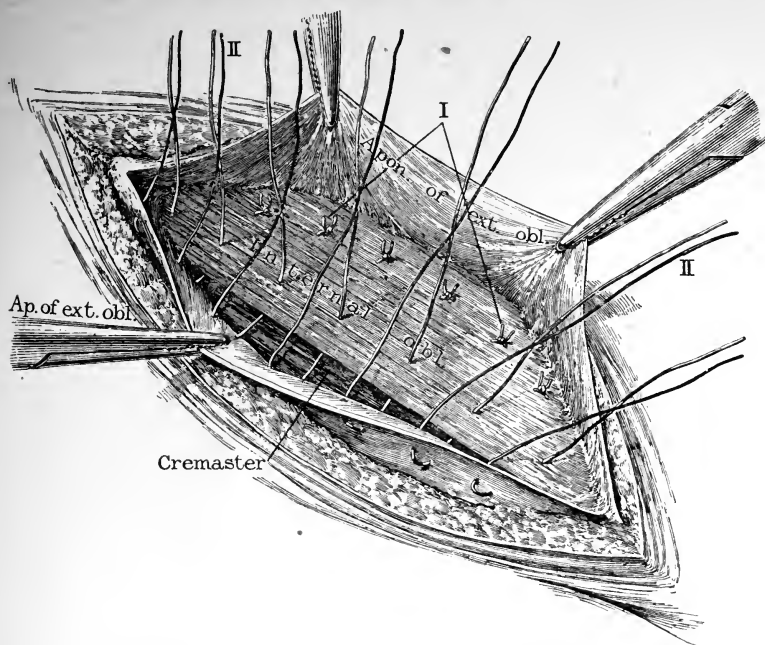

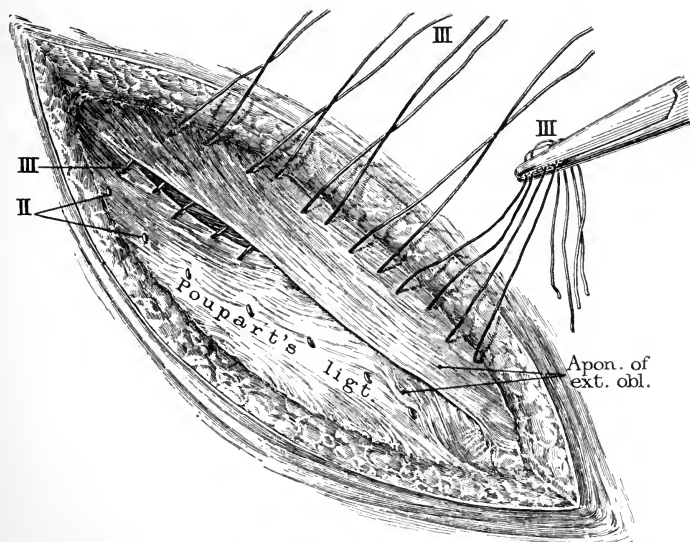FIG. 29. Halstead's operation. Sewing the deep muscles to Poupart's ligament.

FIG. 30. Halstead's operation. Overlapping the external oblique.

The results of this extensive and elaborate operation are very good as regards the cure of the rupture, and Halstead states that not a single

[1] Bloodgood, *Johns Hopkins Reports*, vol. vii., and Wöfler, " Beiträge z. Fest. f. Th. Billroth."

recurrence has been charged to him from 1892 to 1903. The difficulties of following up cases, especially unsuccessful ones, must not be forgotten, however. The writer has performed this operation on many working
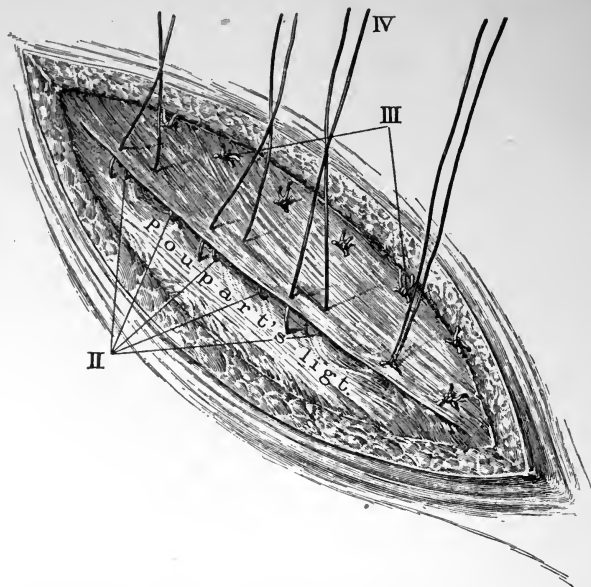

Fig. 31. Halstead's operation. Sewing down the edge of the external oblique.

men since 1905, without yet seeing a recurrence, although none of the patients wear a truss. In two early cases hydroceles followed too free removal of veins; one of these patients came for radical cure for hydrocele two years later.

When it was customary to dislocate the vas deferens, atrophy of
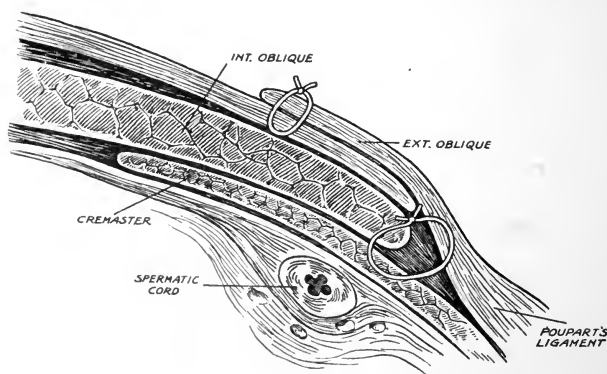

Fig. 32. Halstead's operation. Section to show the overlapping.
(Modified from Halstead.)

testis used to follow the operation in 10 per cent. of the cases, but since 1899 not a single case of this serious complication has been observed at the Johns Hopkins Hospital, although epididymitis and vaginal hydro-

cele are not uncommon. These can be avoided if one of the veins in front of the vas is left, and the testis is well supported by the dressings after the operation.

Halstead's operation in its modern and modified form is no doubt suitable for many cases of large inguinal hernia with large canals and fatty bulky cords. It is particularly applicable when varicocele complicates the hernia. The removal of nearly the whole cord greatly facilitates the radical cure, for " the cord is the first cause of the hernia and the ultimate obstacle to its cure." [1] I do not use nearly so many sutures
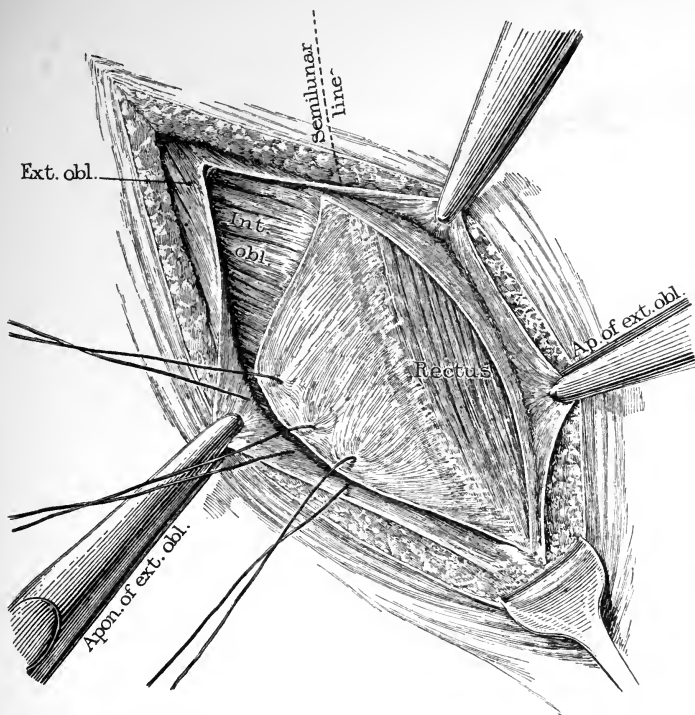

Fig. 33.   Halstead and Bloodgood's operation.   Turning down a flap of rectus sheath to strengthen the lower and inner part of the canal.

as Halstead does when performing his operation. For instance, the interrupted suture drawing the cremaster under the internal oblique can also be made to bring the latter down to Poupart's ligament. Again, I use a continuous suture for overlapping the edges of the wound in the external oblique instead of interrupted ones.

(4) **The Double Filigree Operation.** Mr. McGavin [2] devised this operation for difficult cases incurable by other operations ; especially where the inguinal canal is large, its walls weak or fibrous, where the rupture has recurred, and the patient leads a laborious life. I venture to quote Mr. McGavin's excellent account of his operation :

Operation. " The filigrees are made in two sections—namely, a pubic (a) and an iliac (b), Fig. 33 ; the former is always made of the following dimensions : At the narrow end its width is three-quarters of an

[1] Halstead.   [2] *Brit. Med. Journ.*, August 4, 1909.

inch; at the wide end one and a half inches; its length is also an inch and a half, this being the usual length of the adult inguinal canal. Being constructed on the principle that every filigree, whether abdominal or inguinal, should be made with not fewer than eight loops to every inch of its midrib, this will give thirteen loops on either side of the pubic section of an inguinal filigree. The iliac section (b, Fig. 34) is made in such a way that its inner third corresponds in shape and size to the outer two-thirds of the pubic section. Its outer end must meet the requirements of the case, being trapezoid, square, or, what is more usual, oblong, and of a total length of two and a half to three inches, as may be found necessary. The wire must be of unalloyed silver, and for convenience'
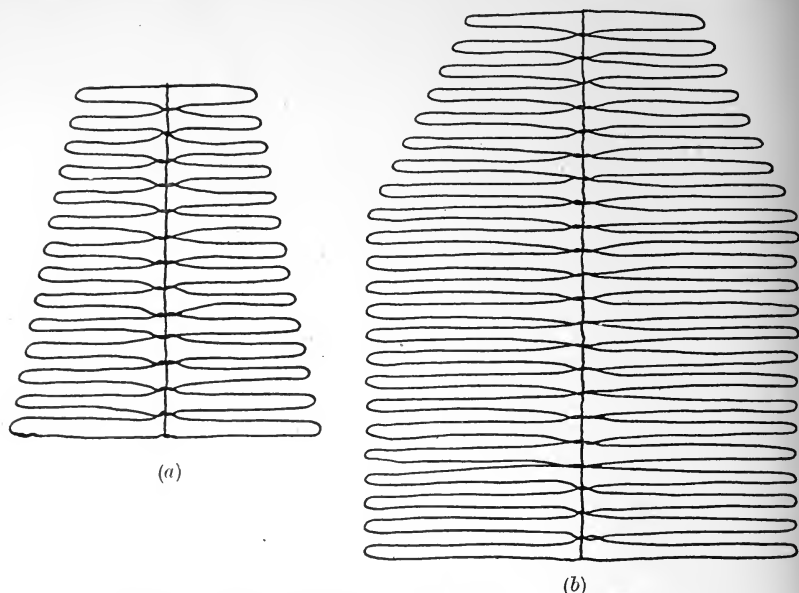

FIG. 34. (a) Pubic filigree. (b) Iliac filigree. (After McGavin.)

sake it is well to keep to the same gauge for all filigrees, namely, No. 28 Standard wire gauge. . . .

"As perfect asepsis is imperatively necessary here, indeed even more so than in the case of abdominal filigrees, it may be said that the filigrees should be placed in ether for five minutes to remove all grease from them, and should be left in the steriliser *in the centre of the most actively boiling area*—it is necessary to emphasise this point, as I have seen them placed at one end where there was barely a trace of ebullition—and left there till the moment of implantation, when they are lifted straight from the steriliser into the wound.

"The operation is at first conducted exactly as in performing an ordinary Bassini's closure, except that the aponeurosis should be split to a point rather farther out, and the peritoneum must be more freely separated from the posterior surface of the conjoined tendon, as must the latter be from the aponeurosis overlying it. From this point the steps are as follows: The sac having been isolated and dealt with, the cord is held out of the way and the first two of the sutures which are to approximate the conjoined tendon to Poupart's ligament are inserted,

and their ends are caught by pressure forceps.   These sutures being held
aside by the assistant, the pubic section of the filigree is placed upon the
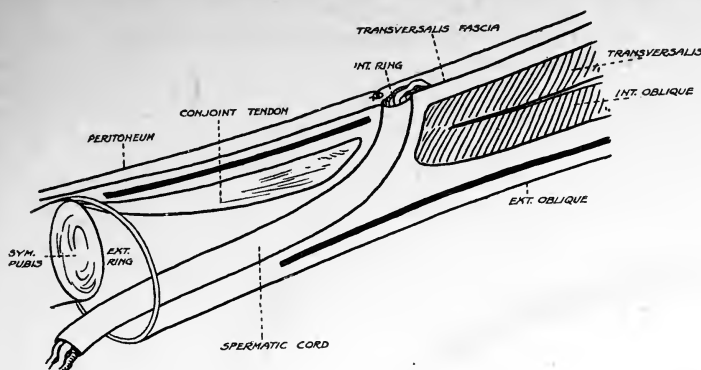peritoneum, its narrow end being close to the pubic spine, and its wide

Fig. 35.   Section parallel to and through inguinal canal with filigrees in place.
(Modified from McGavin.)

end at the inner margin of the internal abdominal ring.   If the peritoneum
is very loose and inclined to sag, a fine suture may be used to unite it to the
filigree ; as a rule, however, this is unnecessary, and all that is required is
to bring the conjoined tendon into close apposition with Poupart's liga-
ment *over the filigree* by the two sutures already inserted, and then to
insert as many more as may be deemed necessary, care being taken to
keep the bed in which it lies as dry as possible.   In cases in which the
muscular wall of the abdomen external to the internal ring is sound and
strong, the cord is placed in position, and the iliac section of the filigree
is taken from the steriliser and is placed beneath the aponeurosis in
such a way that its inner end lies over the internal abdominal ring and
upon the cord for a space of three-quarters of an inch, the outer end
being carried outwards and laid upon the surface of the internal oblique
muscle, one or two sutures holding it in place (Fig. 35).   If the above-
mentioned weakness
is present, the mus-
cular wall is divided
from the ring out-
wards towards the
iliac spine for about
an inch, and is sepa-
rated from the peri-
toneum by the handle
of a scalpel ; upon
this peritoneum the
outer end of the iliac
section is laid, being
lightly sutured in
place, and the
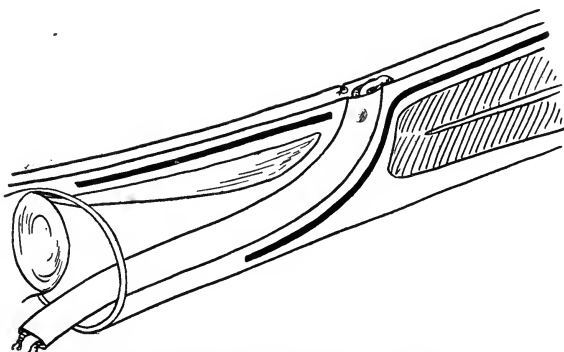muscles are brought

Fig. 36.   Section of inguinal canal with filigrees in
place.   (Modified by McGavin.)

together again over it (Fig. 36); the inner end lies as already described.
Finally, the aponeurosis is sutured in place and the wound closed by
means of Michel's clips, which are removed on the fifth day.
   "It will be seen from this that the cord comes to be 'sandwiched,' as

it were, between two layers of filigree in the canal, the natural relations of which are hardly altered ; and further that the area external to the internal abdominal ring is fortified by a filigree which may be made of any size which may be deemed necessary.

" It is obvious that such a proceeding as I have described must in most cases be comparatively simple in its performance ; it will be found equally satisfactory in its results. Granted a primary union of the wound, the hernial gap will be found to become as impermeable and as unstretchable as a pad of leather. There will be neither pain nor discomfort afterwards ; there is not the least fear of interference with the cord nor with the functions of the testis ; the necessity for any form of truss is done away with permanently, and the operation thus offers the patient a radical cure in the truest sense of the word.

" Now what are the disadvantages of the method, if there are any, to be placed against these points in its favour ?

" I think I may honestly say that the only disadvantage is, that if suppuration should occur, the iliac section, and possibly (although not so probably) the pubic section, may shift their positions ; or if only a slight sinus should develop, that convalescence may be unduly prolonged. It must be understood that the inguinal region is by no means so favourable a site for an aseptic operation as is the abdominal wall when one is dealing with a ventral hernia. If suppuration occurs and the filigrees shift, the probability is that the cure will fail, just as it does in cases where no filigree is used. In this respect the operation differs entirely from that for ventral hernia, where even if sepsis occurs, not only is there no possibility of the filigree shifting its position, but the eventual result is only to fix it more firmly and to consolidate the tissues more thoroughly. In such a case of failure, it is perhaps better to remove the filigree, wait until healing has taken place, and again perform the operation.

" In cases in which the suppuration is purely superficial and slight, and in which it is felt that the iliac section has not shifted, it should on no account be removed, as in most cases it will not affect the result, and careful dressing will usually induce the sinus to close.

" It may be asked why these cases are more likely to break down than other cases of hernia. The answer is that they are the largest and worst cases ; many of them are recurrent herniæ, and therefore the amount of tearing and dissection necessary to separate the layers and make a bed for the filigree commonly results in the oozing of blood serum and fat, which, taken in conjunction with the proximity to the genitals and anus, renders the wound a particularly favourable nidus for bacterial action.

" Since I first devised this operation I have had occasion to perform it in twenty-seven cases, and to these cases I have added three cases operated upon by my colleague, Mr. C. C. Choyce, who has kindly allowed me to publish them, as well as three cases in which a single long filigree was used, the first cases in which I attempted to treat inguinal hernia by filigree ; two of these were in women, and one in a man. Since these latter were done, however, although they have been perfectly satisfactory, I have used only the double filigree method, as it has enabled me to deal with cases which the single filigree would hardly have controlled, and this is especially the case in men, in whom the anatomical conditions necessitate a difference in method.

" The results tend to show that the method is capable of dealing

with herniæ of the largest dimensions, and in patients whose age has hitherto been considered as a contra-indication to operation, owing to the tendency to recurrence."

RADICAL CURE OF FEMORAL HERNIA

There is less necessity for operative interference here, women, in whom the above variety is so much more frequent, finding a truss more efficient and less irksome, owing to their less active life and their mode
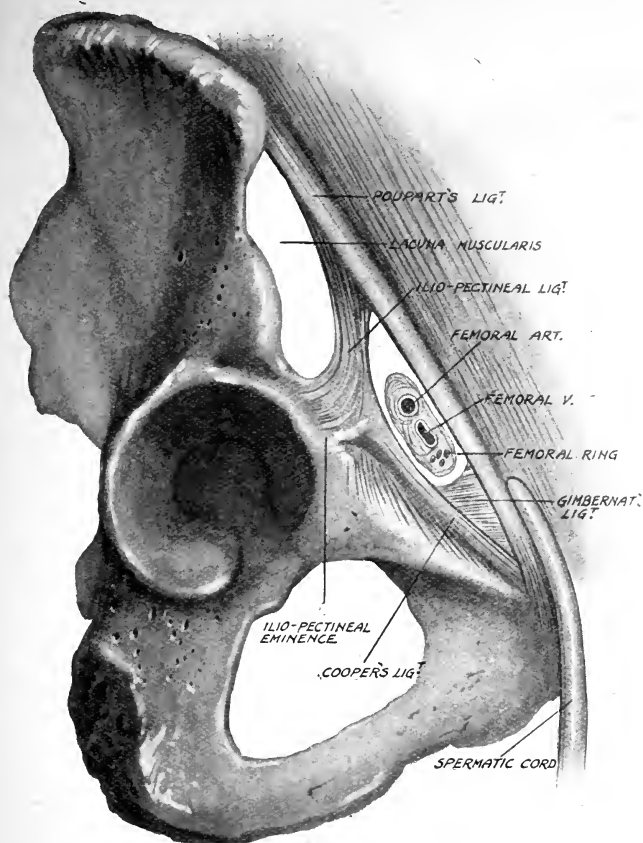

FIG. 37.   Showing femoral sheath and relations of femoral ring.

of dress.   On the other side it must not be forgotten that strangulation is proportionately more frequent, more often overlooked, and more fatal in femoral than in inguinal hernia.   In omental hernia, where there is difficulty in fitting or unwillingness to wear a truss, in irreducible hernia, and in all cases of strangulated hernia, where the patient's condition and the surroundings of the operator admit of it, an attempt should be made to cure the hernia permanently.   We are met here by a difficulty less present in inguinal hernia, i.e. that of closing the canal satisfactorily, owing to the rigidity of some of its immediate surroundings and the importance of others.

The Incision. An oblique incision is made starting an inch above the middle of Poupart's ligament, and extending downwards and inwards over the saphenous opening. The lower fibres of the external oblique and Poupart's ligament are defined, and the cribriform fascia incised. The fascia propria of Astley Cooper is incised, and the sac sought in the extra-peritoneal fat.

Finding the Sac. Care must be taken not to mistake the distended fascia propria—the anterior wall of the femoral sheath—for the sac, and the sub-peritoneal fat for adherent omentum.

A. Different Methods of treating the Sac.

(i) The empty sac, having been thoroughly separated from its surroundings—a step here usually carried out with ease—is transfixed, and tied as high as possible, and then thoroughly invaginated within the femoral ring.

(ii) Kocher's method (p. 53) may be employed. The empty sac, having been isolated, is invaginated into the abdominal cavity by means of a pair of long curved forceps, and then brought out through a small opening made in the whole thickness of the abdominal wall above Poupart's ligament, and its stump fixed there by suture.

(iii) The sac may be isolated and emptied, and its neck thoroughly cleared with the finger passed up the femoral canal. The neck is now ligatured as high up as possible, the body of the sac cut away, and the ends of the ligature, which have been left long around the neck of the sac, are carried up the femoral canal by means of needles on handles along the index finger, and made to emerge in front of the peritoneum through the external oblique aponeurosis just above Poupart's ligament, about half an inch apart. When these are tied the neck of the sac and any funnel that may remain above the ligature will be drawn away from the region of the femoral ring. While the above ligatures are being passed one assistant should protect the femoral vein, while another draws up the upper angle of the skin incision so that the needles may emerge in the wound.

(iv) The sac, having been isolated below Poupart's ligament, may be drawn upwards through the femoral canal into a wound made by slitting the fibres of the external oblique muscle ; its neck can then be tied higher up than by mere separation and traction from below (*vide* Lotheissen's Operation).

B. Closure of the Femoral Canal. The other cardinal step in the radical cure of femoral hernia—closure of the femoral canal and ring—is much more difficult here, for reasons above given.

(1) *Bassini's Method.* After high ligation and removal of the sac the canal is closed in the following manner : Three sutures are passed through Poupart's ligament and the pectineal fascia (*see* Figs. 38 and 39). These are left untied, while three or four more sutures are inserted and tied. These unite the falciform ligament to the pectineal fascia, the lowest being placed close to the saphenous vein. Bassini has published fifty-four cases operated upon by this method, without any recurrence in forty-one cases, traced from one to nine years.

(2) *Lockwood's Method* [1] (Figs. 40 and 41). The stump of the sac is first drawn up and fixed as above described (iii, p. 64). The subsequent steps are described by the author as follows : " For this purpose the index finger of the left hand is pushed up the femoral canal so that

[1] *Hernia, Hydrocele, and Varicocele,* p. 192.

it lies with its dorsum against the common femoral vein, and its tip upon and a little within the ilio-pectineal ridge. The finger is intended
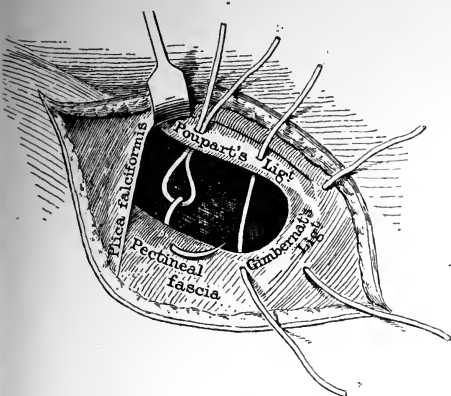

FIG. 38. Bassini's operation for femoral hernia (modified from Binnie's *Operative Surgery*). Passing the first set of sutures.
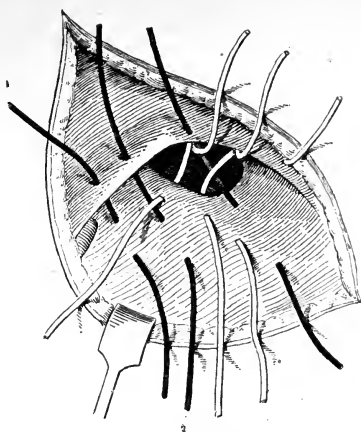
FIG. 39. Bassini's operation for femoral hernia (modified from Binnie). The second set of sutures ready for tying.

to protect the vein from the point of the herniotomy-needle, and to guide the latter as its point is thrust beneath Cooper's ligament (*see* Fig. 40). In cases in which the femoral canal has been distended and stretched the needle can be guided by vision. The herniotomy-
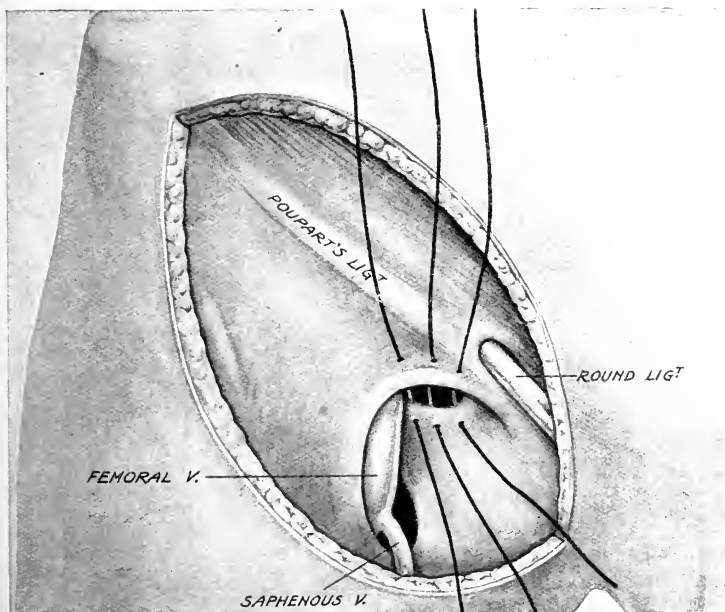

FIG. 40. Lockwood's operation. Showing the mode of suturing the femoral ring.

needle is passed in the following manner: Having been armed with about one and a half feet of No. 4 or 5 twisted silk,[1] its point is guided

[1] Catgut is better.

up the femoral canal until it rests against the inside of the linea ilio-pectinea, opposite the outer edge of Gimbernat's ligament. The needle is then rotated so that its point scrapes over the linea ilio-pectinea and picks up Cooper's ligament. Finally, the point emerges through the upper part of the pectineal fascia, where it is unthreaded and withdrawn, leaving the suture beneath Cooper's ligament (*see* Fig. 41). Additional sutures are passed in exactly the same way, but each a little farther outwards, until the last lies at the inner edge of the common femoral vein. Two or three sutures generally suffice, but I have used as many as five. The next step is to again thread the upper end of each ligature in turn through the herniotomy-needle, and, by pushing
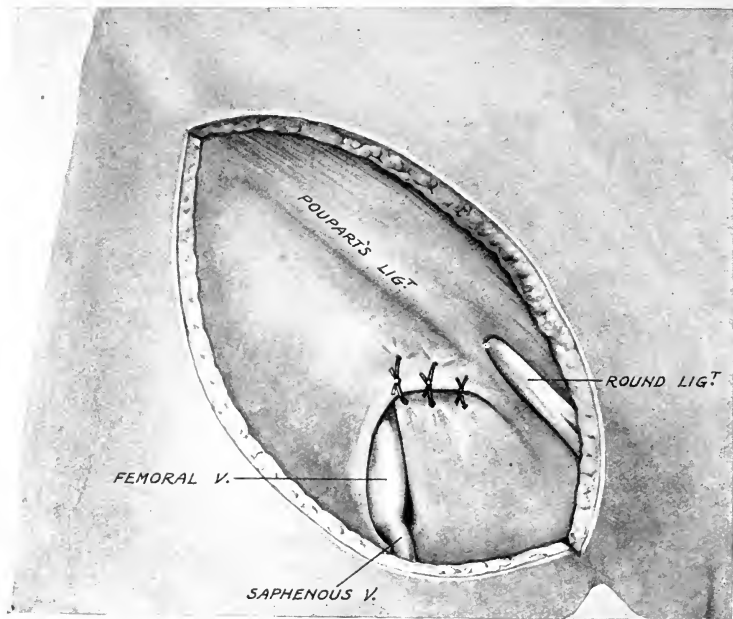

FIG. 41.   Lockwood's operation.   Showing the closure of the femoral ring completed.

the point of the needle half-way up the femoral canal and rotating it forwards, pass the thread from within outwards through Hey's ligament close to its junction with Poupart's ligament (*see* Fig. 40). Before knotting these threads they are pulled tight, to see whether enough have been passed to make a thorough and firm closure of the femoral canal, but without compressing the femoral vein (*see* Fig. 41)." The final results of Mr. Lockwood's cases are not fully given, owing to the difficulty in following them up. Ten cases, however, are mentioned. In nine of these the result was satisfactory after periods varying from one to seven years; the tenth case relapsed suddenly at the end of six months.

Kocher's method differs very little from the above; he sews Poupart's ligament down to the ligament of Cooper and the pectineal fascia and muscle.

Professor De Garmo,[1] after ligaturing the sac high up and removing it, closes the femoral canal in a manner almost identical with that of Kocher.

[1] *Ann. of Surg.*, vol. xlii, 1905.

Since 1890 De Garmo has used his method for 110 cases, with only one certain and one doubtful recurrence, and one death, which occurred in a late case of strangulated hernia from perforation of the bowel after its reduction by operation. Of the 110 herniæ, 28 were strangulated at the time of the operation, and the remaining operations were simple radical cures. In three of the patients the hernia had relapsed after operation elsewhere; all these recurrent cases have remained well for over four years.

The above results are somewhat misleading, for it is not stated how many of the cases were traced and thoroughly examined. It is written that " by far the greater number have been traced and the permanence of the cure ascertained "; this is too vague to be of much value. Again, the time of observation is not mentioned, although it is probable that it extended over some years in the majority of the cases. It is pretty certain that recurrences after the radical cure of femoral hernia come late, the majority appearing after two years if the canal has been closed by sutures.[1]

Hutchinson carefully observed sixteen of his own cases treated as above.[2] The patients were traced for from two to ten years. Two relapses occurred, one after three years; the other came earlier in a case of strangulated hernia in a woman who had bronchitis after the operation.

(3) *The Purse-string Method of Cushing and Curtis*, adopted by Coley.[3]

FIG. 42. Diagrammatic section to illustrate Lotheissen's operation for femoral hernia.

After high ligation of the sac and removal of all subperitoneal fat from the femoral canal Coley closes the femoral canal high up with a purse-string suture of kangaroo tendon. This stitch is introduced through Poupart's ligament near its inner end, then through the pectineus fascia and muscle, the fibrous septum of the femoral sheath internal to the femoral vein, and forwards through Poupart's ligament about a quarter of an inch from the point of entry. This suture can be passed more safely in the opposite direction, the femoral vein being more easily avoided.

This operation is very simple and can be performed quickly; hence it is especially useful in critical cases of strangulated hernia.

Coley [4] publishes 50 cases with no recurrence, also 16 operations by Bassini's method, with one relapse in a patient whose wound had suppurated.

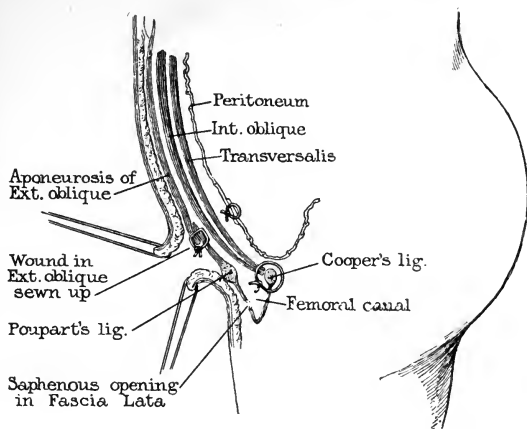Of these 66 cases, 46 were traced for from one to ten years, and 34

[1] Kammerer, *Ann. of Surg.*, p. 983, vol. xxxix, 1905.
[2] *Lancet*, vol. i, 1906, p. 964.
[3] *Ann. of Surg.*, vol. xxxvii, p. 801, 1903.
[4] *Loc. supra cit.*

from two to ten years. The chief objections to this operation are that it is difficult to retain such rigid structures as surround the femoral canal by a purse-string suture, and that the femoral vein is especially liable to be wounded.

(4) *Lotheissen's Operation* [1] (Fig. 42). An incision is made half an inch above and parallel to the inner half of Poupart's ligament, separating the fibres of the external oblique aponeurosis.

The edges of this incision are retracted and the neck of the sac exposed and isolated just above the femoral ring and below the curved margin of the internal oblique and conjoined tendon. The empty sac can generally be drawn upwards into the wound, but with large and irreducible herniæ this is not possible ; in them the lower border of the cutaneous wound is freed and retracted sufficiently to expose the sac at the saphenous opening in the usual way. The sac is opened and emptied, and its ligated stump is drawn upwards through the femoral canal into the wound in the external oblique. The neck of the sac is then easily tied so high that no funnel can remain above the ligature.

The essential part of the operation, however, is the closure of the *upper end* of the femoral canal by joining the lower margins of the internal oblique and transversalis to Cooper's ligament.

Sutures of catgut are passed by means of curved round needles first (*see* Fig. 43) through the mobile muscular arch and then under Cooper's ligament, which is fixed (*see* Fig. 43). The first suture should be passed close to Gimbernat's ligament, and the last near the femoral vein, the point of the needle being guided by the finger (introduced through the saphenous opening), which should also carefully protect the femoral vein. Three sutures are generally enough. Care must be taken not to wound or compress the vein with the last suture. In males the conjoint tendon is secured to Cooper's ligament behind the spermatic cord, which is held out of the way.
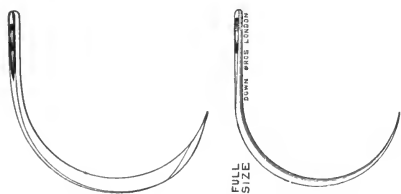

Fig. 43. Symonds' needles.

The wound in the external oblique is now closed by a continuous catgut suture. The writer overlaps the edges of this wound to give greater support. Two years later Gordon described an operation almost identical with the above.[2]

According to Gilli, this operation is frequently performed at Von Hacker's clinic, and with very good results.[3]

This seems to me to be the operation which most closely approaches the anatomical ideal, for the canal is closed at its upper end, instead of lower down, as in all the older operations, and the sac can be tied at a higher plane. In practice it is not very difficult to perform, if only suitable needles be employed. An oblique skin incision starting above the centre of Poupart's ligament and extending downwards and inwards over the saphenous opening is more generally useful than the horizontal one, and this is especially true for irreducible and strangulated herniæ, in which the sac has to be isolated and emptied from below Poupart's ligament.[4] The writer has used this method for the majority of his cases of both ordinary and strangulated hernia during the last seven years,

[1] *Centralblatt für Chirurgie*, 1898.   [2] *Brit. Med. Journ.*, vol. i, 1900.
[3] *Centralblatt für Chirurgie*, 1903.   [4] *See* p. 63.

without a known recurrence. In one case thrombosis of the femoral vein followed in a weak woman who had two strangulated femoral herniæ within a fortnight; the first was associated with tetany.

The operation is not easy in very stout patients; the conjoined tendon and internal oblique muscle are then fatty and difficult to define in a deep wound.

In conclusion it seems to me that Lotheissen's operation, being the one most anatomically ideal, is destined to become the operation of the future, but more statistics are needed before coming to a decision. The operations of Bassini, Lockwood, and Kocher have stood the test of time, and give very good results. It is probable that in the future the results of operations for the radical cure of femoral hernia will become as good as those for inguinal hernia.

RADICAL CURE OF UMBILICAL HERNIA

This operation is very rarely called for in children, in whom the natural tendency to cure is very great. In adults the patients usually met with—stout women of middle age, with damaged viscera, bronchitis, &c.—are not very good subjects for operative interference. Formerly the results of the operation were so bad that the name of " radical cure " could hardly be given to it.

Berger states that relapses used to occur in 15 to 25 per cent. of the small, and 30 per cent. of the large, herniæ.

Winslow [1] states that until recently 50 to 75 per cent. of relapses occurred in the cases of large umbilical herniæ, even in the practice of the best operators; and that 50 per cent. of the strangulated cases died.

The recent improvements in the methods of operating and the consequent amendment of the results justify a more frequent use of the operation with the object of preventing strangulation, which is attended with such fatal results in this form of rupture. It is also very important to operate early, while the protrusion is still small, for the prognosis of the operation varies almost inversely with the size of the hernia. Busse found that 75 per cent. of recurrences occurred in the cases of large herniæ, 50 per cent. in the medium-sized, and none in the small ones (from the size of a hazel nut to that of a walnut).

Suppuration had not occurred in any of these cases.

A radical cure may be performed—

(a) After the operation for relief of strangulation in suitable cases.

(b) In those rare cases of infantile hernia where the wearing of a suitable truss has not been sufficient.

(c) In congenital hernia of the new-born child. In these cases, either herniæ into the root of the cord, or (from deficiency of the abdominal walls) partial eventrations, interference is often out of the question from the co-existence of other malformations. If the hernia be uncomplicated, and the child appear likely to survive otherwise, an attempt should be made by abdominal section to return the contents, refresh the edges of the opening, and unite them with sutures.

(d) In most cases of small and medium-sized hernia in the adult, unless the rupture is easily retained by means of a truss or a belt, granting that the patient's general health is good enough to enable her to bear the operation, and the subsequent rest in bed.

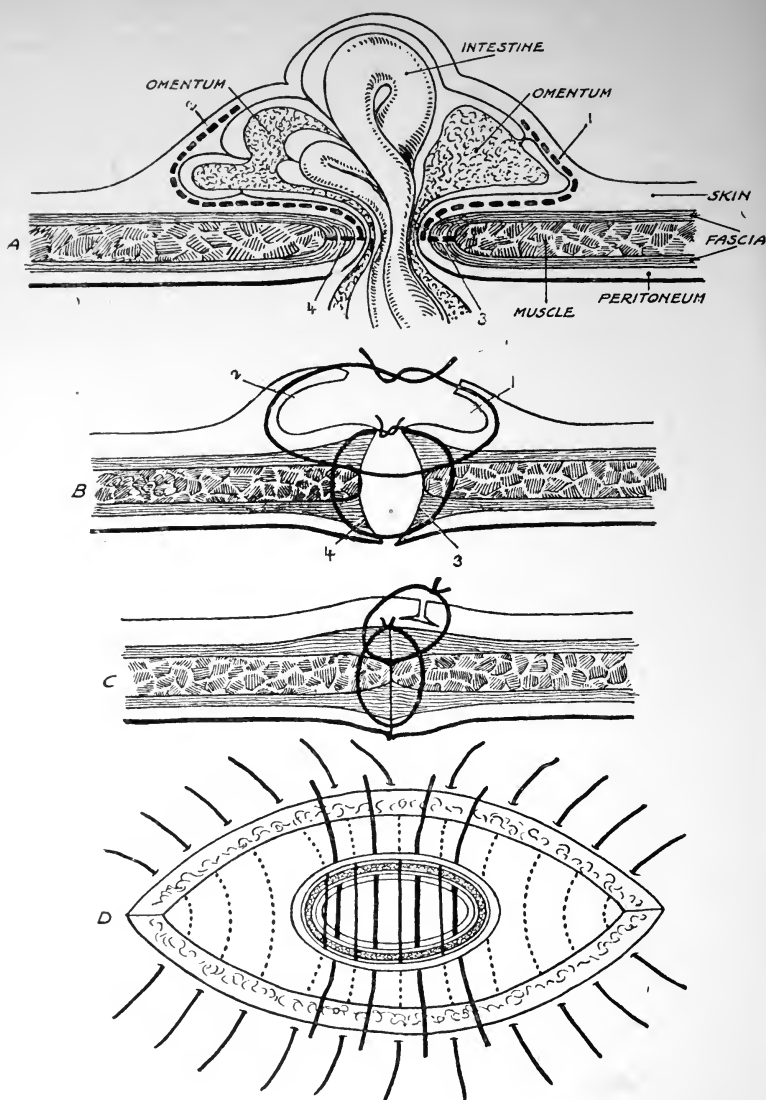[1] *Ann. of Surg.*, vol. xxxix, 1904, p. 245.

Fig. 44. Greig Smith's method of radical cure in umbilical hernia. *A*, Transverse section through hernia and parietes, showing sac, contents, and ring. IN, Intestine. OM, Omentum. SK, Skin. F, Fascia thickened at margin of ring. M, Rectus. P, Peritoneum. 1, Incision through skin of sac, which is continued along the sub-peritoneal tissue to the margin of the ring. 2, The same on the opposite side. 3 and 4, Incisions carried deeply through thickened fascia around the ring to expose the recti. *B*, Gut returned, omentum removed, superfluous skin and sac removed, sutures placed, incisions in fascia opened up, and recti exposed. References same as in *A*. *C*, Sutures tied, skin-suture to one side of parietal line of junction. *D*, Bird's-eye view showing double set of sutures around umbilical ring and cutaneous wound.

It should be the surgeon's aim to prevent, as far as possible, the development of (i) strangulation, and (ii) also to prevent the growth of those large inflamed, and often inoperable, herniæ which are to be

seen far too frequently. Earlier operation in suitable cases will do much to avoid these serious complications. The neck of the sac may be transfixed and tied, or even displaced as in inguinal hernia, but it is better to sew it up in most cases.

Operations. The old operation in which, after dealing with the sac, the fibrous edges of the ring were sutured together is to be strongly condemned, because the tension on the stitches is so great that the latter may give way or tear out, and lead to an early reappearance of the hernia and strangulation, or to a more certain recurrence later.

(1) *Simple Suture of Separate Layers.* In small herniæ, and especially in the infantile variety, a simple method is to explore the hernia and reduce the contents, and then, after excising the sac and its coverings, to incise the fibrous edges of the ring so as to expose the margin of each rectus muscle. The wound is then closed by separate layers of sutures, one for the peritoneum and the deep layer of the rectus sheath, one for the muscles and the anterior layer of the sheath, and one for the skin. The objection to this method is that the wound is a direct and not a valvular one, and that this makes a recurrence likely if the abdominal tension be much increased later (Fig. 44).

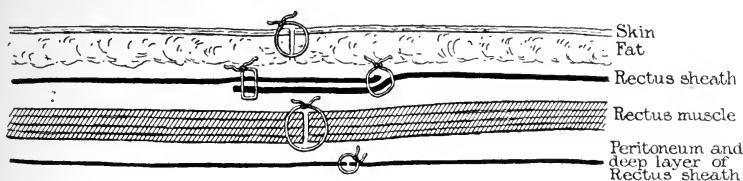(2) *The Lateral Overlapping Method.* In these cases it is clearly

FIG. 45. The overlapping method of sewing the abdominal wall. (Modified from Winslow, *Ann. of Surg.*)

better to suture the various layers in the overlapping manner so strongly recommended by Winslow [1] (*see* Fig. 45).

Winslow quotes Coley to the effect that Bull and Coley had twelve relapses after simple suture of separate layers in twenty-one cases of ventral and umbilical hernia.

In the majority of cases, however, the hernia is large, its coverings thin, and the recti widely separated and atrophied. In these it is generally impossible to keep the muscles and aponeuroses together by simple suture without undue tension on the stitches, which may tear out and lead to an early and sometimes a disastrous return of the rupture. For the same reasons Winslow's method of suture is impracticable. For these cases one of the flap methods is suitable, and Mayo's operation is by far the simplest and the best. It is based on the fact that in the subjects of umbilical hernia the abdominal wall is too long and pendulous in a vertical direction, so that it is far easier to overlap from above downwards than from side to side.

(3) *Mayo's Operation.*[2] An elliptical incision is made in a transverse direction around the hernia near its base, and the aponeurosis of the external oblique is thoroughly exposed for a distance of $2\frac{1}{2}$ in. to 3 in.

[1] *Ann. of Surg.*, vol. xxxix, 1904, p. 245.
[2] *Journ. Amer. Med. Assoc.*, July 25, 1903. Piccolo and Sapejko have also described the operation (*Centralblatt für Chirurgie*, 1900, p. 36).

around the margin of the hernial aperture.   The fibrous and peritoneal coverings are divided all round the very neck of the rupture, and the hernial contents are easily examined here, because there are rarely any adhesions at the neck.

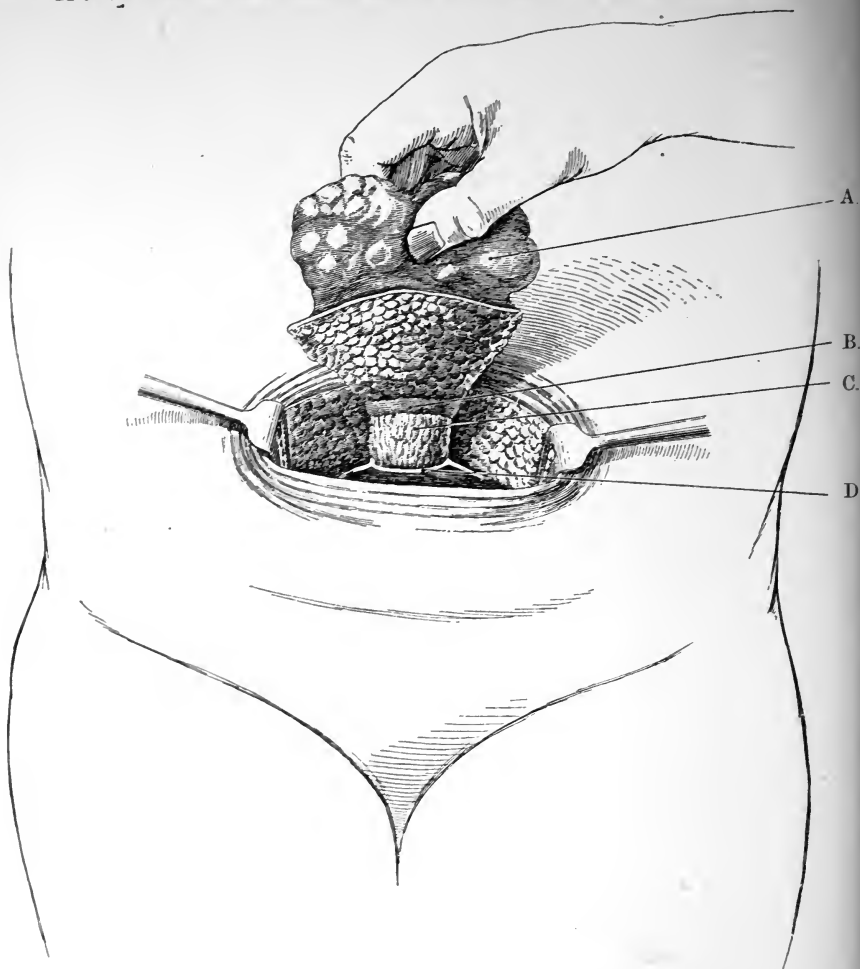If the intestine be adherent within the body of the sac these adhesions

FIG. 46.   Mayo's operation for umbilical hernia.   A transverse elliptical incision has been made to expose aponeurosis and neck of sac.   (*Ann. of Surg.*)

A, Lobulated hernia.   B, Neck of sac.   C, Omentum.   D, Hernial orifice.

can be more easily and safely separated by working forward along the free bowel found at the neck.   This is reduced, and the omentum ligatured at the hernial orifice.   The sac, with its thin and adherent coverings, and omental contents, are then rapidly removed in one mass without any of the troublesome and tedious dissection which is usually necessary when the sac is opened at its fundus (*see* Fig. 46).

The hernial orifice is examined, its long axis is generally transverse, and its edges are more easily approximated by traction on its superior

and inferior edges. The aponeurotic ring is widened by making two transverse incisions from its lateral poles, each extending for an inch or more outwards, thus making superior and inferior aponeurotic flaps. The peritoneum is now separated from the deep surface of the upper flap, and the lower flap is drawn up behind the upper one by means of strong mattress sutures. Before these sutures are tied traction is made upon them to allow the peritoneum to be closed by a continuous catgut suture (see Fig. 47).

The mattress sutures are tied, and the lower edge of the upper flap is sewn to the front of the base of the lower one (see Figs. 48 and 49).
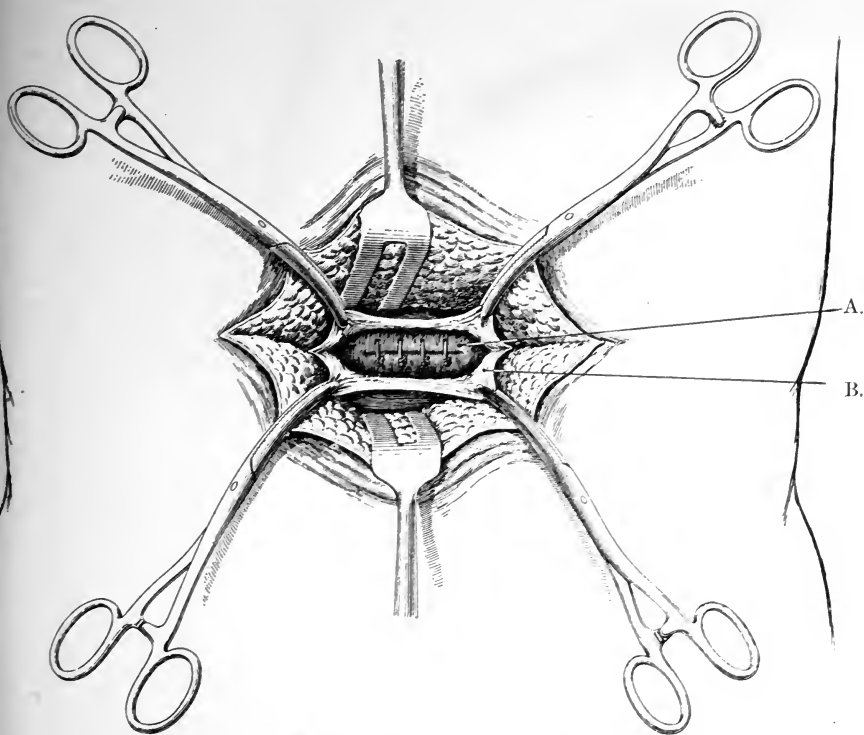

FIG. 47.   Mayo's operation.   (Ann. of Surg.)
A, Peritoneum sutured.   B, Aponeurosis retracted.

In some cases lateral flaps may be more easily obtained, and should then be employed.

Mayo reported thirty-five cases of umbilical hernia operated on by his method, with only one slight recurrence in one of the ten cases in which he had used lateral flaps. Moynihan[1] also publishes eleven recent cases, and strongly recommends the operation. The writer has used this method extensively during the last seven years and has found it very satisfactory.

Although it is early to conclude that these good results will remain permanent radical cures, yet they compare very favourably with those obtained by other methods.

Noble, Ferguson, and others have used flaps of the anterior wall of
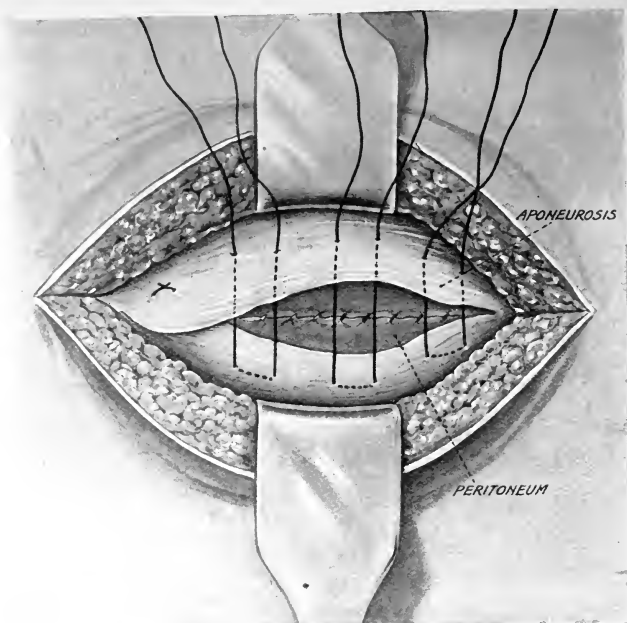
[1] *Lancet*, July 23, 1904.

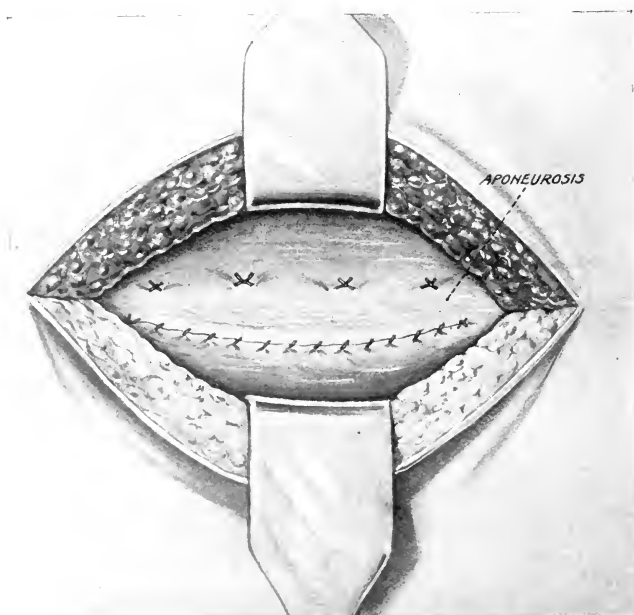FIG. 48. Mayo's operation. Aponeurosis sutured in an overlapping way with mattress sutures.

FIG 49. Mayo's operation for umbilical hernia. Mattress sutures tied. Continuous suture holding down edge of flap.

the rectus sheath to close the hernial orifice, the base of each lateral flap being at the margin of the ring; the flaps are then rotated inwards and sutured together, so that the surfaces formerly anterior now become posterior.

Barker, Lucas Championnière, and others have attempted to secure a broad union by inverting the edges of the hernial aperture by means of Lambert sutures passed through the anterior surfaces of the sheaths of the recti.

None of these operations, however, can be compared in value with that described by Mayo.

(4) *The Implantation of Silver Wire Netting or Filigree.* For very large umbilical and ventral herniæ this method has been strongly recommended by Witzel, Phelps, Willy Meyer, Göpel, Bartlett, and McGavin.

For such cases formerly considered incurable, yet greatly in need of surgical aid, this operation may be tried if the patient's general health be good enough, and the coverings of the rupture can be rendered aseptic. A properly fitting and elastic belt should, however, be always well tried first, and in the majority of cases will be found sufficient. Winslow's remarks [1] upon this subject, although somewhat too pessimistic, are well worthy of remembrance, and may be quoted in full: " Such a mode of support [wire netting] has of course no anatomical basis, and but limited surgical application, though of undoubted value in those exceptional cases in which it is unfortunately appro-

FIG. 50. A section to illustrate Mayo's operation for umbilical hernia.

priate. It does not appear to be appropriate as a routine treatment of hernia. Since acting as a foreign body the silver wire tends to set up suppuration and sinus formation, which weaken the wound, and defeat the very object for which the wire netting is used. The indication for the netting is to reinforce the abdominal wall in cases where, owing to thinning out of stretched structures entering into the hernial orifices or to removal of diseased tissue, normal approximation of the abdominal wall cannot be secured."

Witzel [2] in his first case constructed a rude network in the wound by approximating the edges as far as possible with wire sutures and then weaving the wire amongst these sutures.

Göpel [3] published an account of his work with ready-made silver-wire netting, and pointed out that this method saves much time, and that the tissues are less damaged and constricted.

He reported eleven cases of umbilical and ventral hernia and seven of inguinal hernia with only two failures. The wires had to be removed

[1] *Loc. supra cit.*
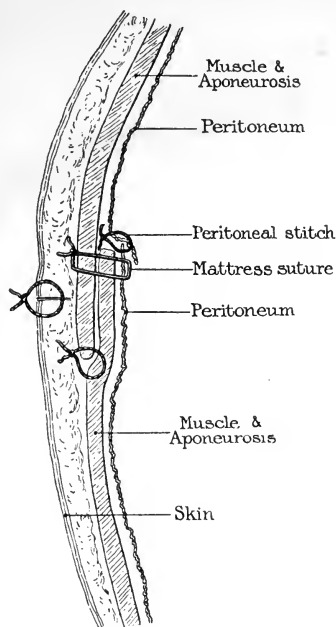[2] *Centralblatt für Chirurgie,* 1900, pp. 257, 459, and 1149.
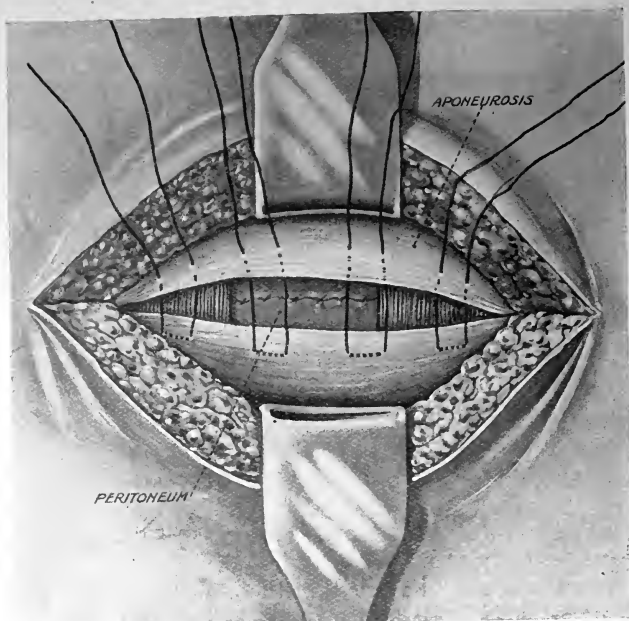[3] *Ibid.* p. 458.

Fig. 51.   Kelly's modification of Mayo's method.   The recti are not divided, only the anterior aponeurosis is overlapped.
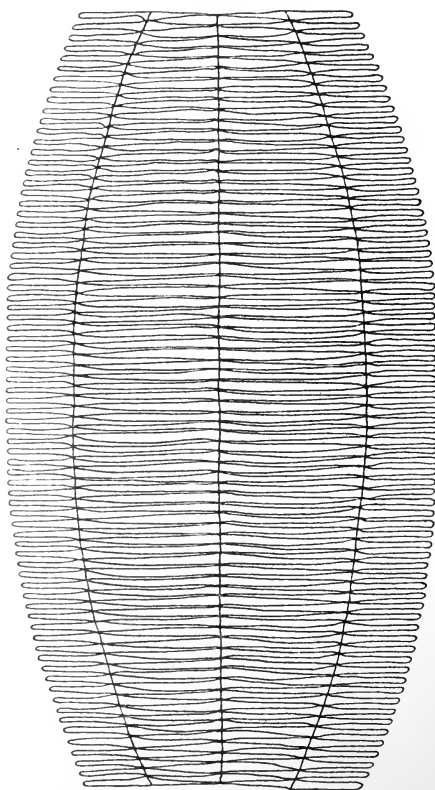

Fig. 52.   McGavin's wire filigree.

in these two cases owing to the formation of blood-clots in the wounds.

Willy Meyer [1] reports three operations, two on very large ventral herniæ, with a very slight recurrence in each after sinus formation in one and fascial necrosis in the other. In each the recurrence came within six months of the operation, which was ultimately successful in greatly relieving the patient. The other operation was for an umbilical hernia of moderate size, and no recurrence had appeared a year later. It is probable that Mayo's operation could have been performed in this case.

Bartlett [2] maintains that the netting generally used, consisting of wires woven at right angles to one another, is too firm and inelastic to amalgamate properly with the mobile abdominal wall. He also holds that only those wires running at right angles to the axis of the wound are necessary, for wounds only stretch laterally to any appreciable extent.

He has operated in seven cases—six ventral and one umbilical hernia—with no suppuration, no removal of filigree, and only one partial recurrence, which occurred in a man suffering from ascites. This was Bartlett's first case.

One patient, the subject of umbilical hernia and cirrhosis, died suddenly on the eleventh day after the operation, and the cause of death was not ascertained. The patients had not been observed long enough to justify the conclusion that the results will remain good. Only two of the cases had been followed for more than a year, and recurrences often come late after radical cure of umbilical hernia.

Operation. The sac and its contents having been dealt with, the layers of the abdominal wall around the ring are dissected apart. The peritoneum and the posterior wall of the rectus sheath are separated from the deep surface of the muscles for several inches, and then sutured by a continuous wire suture. A silver filigree one and a half times as long as the hernial aperture, and $1\frac{1}{2}$ in. broader, is then inserted between the recti and their posterior coverings, and secured in position by a few sutures which pass round the longitudinal wire and through the rectus sheath. No attempt is made to fix the ends of the loops, for Bartlett has proved that this is unnecessary and damaging to the tissues. The loops become well secured by the granulation tissue that forms within and around them. The edges of the muscles and their fascial coverings are then drawn together as much as possible by mattress-wire sutures, and if considered necessary another filigree may be implanted over the anterior sheaths of the recti, and the skin and fascia united over it.

Bartlett makes a silver netting to suit each case by twisting silver wire (gauge 27) round the ends of nails driven through a board. It is to be noticed that the net has no sharp corners or irritating angles, which might injure the tissues and lead to hæmorrhage, serous effusion, and sinus formation. McGavin uses the filigree shown in Fig. 52.

Operations for Ventral Hernia. A ventral hernia can be treated in one of the various ways described above as suitable for umbilical hernia, and therefore no special description is called for here.

[1] *Ann. of Surg.*, vol. xxxix, 1902, p. 767.   [2] *Ibid.* vol. xxxviii, 1903, p. 47.

CHAPTER III

PERITONITIS

OPERATION FOR DIFFUSE PERITONITIS

OPERATIONS have to be undertaken sometimes for diffuse peritonitis of uncertain origin. The following classification of the causes may be useful :

(1) **Peritonitis set up by disease or injury of the intestinal tract, whether accompanied by perforation or not.** Instances of this group would be hernia, appendicitis, intestinal obstruction, malignant disease, suppurating mesenteric gland, gastric ulcer, duodenal ulcer, jejunal ulcer, perforation of Meckel's diverticulum, perforation of a diverticulum of the colon, especially common in the sigmoid flexure, typhoid perforation.

(2) **Peritonitis set up by mischief in other viscera than the intestine, whether accompanied by perforation or not,** *e.g.* a suppurating ovarian cyst, twisted ovarian pedicle, salpingitis, rupture of pyosalpinx, septic metritis, puerperal peritonitis,[1] ruptured bladder, suppurating gallbladder or spleen.

(3) **Pneumococcal peritonitis.**

(4) **Rupture of an abscess in the abdomen or parietes, especially appendicular abscess and sub-diaphragmatic abscess.** These will be taken separately. Of these by far the most common are perforation of the appendix, rupture of an appendicular abscess, perforation of a gastric or duodenal ulcer, and rupture of a pyosalpinx. In elderly people it is particularly important to remember the possibility of a perforation of a diverticulum of the colon.

Operation. In these cases the operation must begin as a thorough exploration. Therefore a long vertical incision near the middle line is adopted, a free opening being made so that the whole abdomen may be thoroughly and rapidly examined in a systematic way (Ch. I.). The result of the operation depends a great deal upon the speed, judgment, and care of the surgeon, who cannot afford to be delayed or hampered by a small incision. The edges of the wound are carefully protected to prevent contamination. Directly the peritoneum is opened liquid and gas frequently escape. Much may be learnt from the character of these. Odourless gas nearly always indicates perforation of a gastric or duodenal ulcer ; offensive gas, disease of the appendix or of the lower part of the intestines. Thin straw-coloured fluid with or without flakes of lymph generally points to a perforation of the stomach.

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[1] I fear the pathology and the published cases in which abdominal section have been resorted to here are alike most unfavourable. If the surgeon interfere early, he will probably only find a congested condition of the peritoneum. If he wait till tympanites and purulent effusion be present, his efforts at relief will, I fear, be equally futile in the face of this severe general septic infection.

Occasionally solid particles of food are also seen. Bile-stained liquid usually indicates perforation of a duodenal ulcer, but occasionally of the gall-bladder. When the liquid is brown and offensive the perforation is almost certainly in the ileum or colon; when it is blood-stained the omentum and mesentery are examined for fat necrosis indicating acute hæmorrhagic pancreatitis. The part indicated is at once examined and the suspicion is confirmed by the presence of thick adherent lymph near the site of perforation. When there are no definite indications the appendix is first examined because it is the most common cause of diffuse peritonitis. If this is healthy the stomach, pancreas, gall-bladder, and duodenum are carefully examined. If this examination is negative the pelvis is examined, for there may be a perforation of a pyosalpinx or, in patients over middle age, of the sigmoid flexure above a growth or at an inflamed diverticulum. When the cæcum is distended the colon must be carefully examined for growth or perforation. A perforation of the small intestine is indicated by the presence of adherent lymph in its neighbourhood. Meckel's diverticulum should not be forgotten. Prolapse of the intestines is to be carefully avoided, for this increases shock and adds to the duration and difficulties of the operation.

Remove the cause. Whenever possible the cause of the peritonitis is removed. For instance, the appendix is removed or a perforated ulcer closed.

Cleansing the peritoneum. When the infection is general or diffuse the quickest method is irrigation. One or more supplementary small incisions are made at the lower part of the abdomen and a large rubber tube is introduced through each of these into the pelvis. Then a soft rubber tube with a funnel attached is introduced through the exploratory incision and is directed by the hand first above the liver and spleen, then into each loin and between the coils of small intestine, and lastly to the pelvis. Meanwhile the fluid runs away freely by the tube above the pubes, and the irrigation is continued until the issuing fluid is clear. Excess of fluid is removed and the pelvis is thoroughly dried by means of several gauze rolls passed from the lower angle of the wound and left *in situ* for a few minutes while the sutures are being introduced.

Drainage. The question of drainage is a very difficult one to decide. In early cases of spreading, but not general, peritonitis surgeons are draining less and less. Wilkie[1] has pointed out a simple method of getting immediate aid in this important matter during the operation. I venture to quote his remarks in full :

"By careful microscopic examination of stained films of the peritoneal exudate one can gauge fairly accurately what is the relation between the two important factors, viz. the patient's resistance and the virulence of the bacteria for the patient. Such an examination can be made in the operating theatre in a few minutes ; the film can usually be stained and examined long before the surgeon has completed his work, so that he may also have the benefit of such accurate information as it affords in deciding the question of drainage."

"After three and a half years' experience of this method of immediate microscopic examination of the exudate in cases of free peritonitis I am fully convinced of its value."

"From a prolonged study of films from experimental peritonitis in animals I found that it was possible from a glance at a film made from the peritoneal fluid not only to foretell whether the animal would recover or would die, but, in the latter case, to gauge fairly accurately the number of hours it would live."

[1] *International Clinics*, vol. iv, Twenty-second Series.

We know that as a rule when bacteria invade the peritoneal cavity fluid is poured out, and for the first two or three hours there are but few cells in the exudate. During this early stage the bacteria disappear to a great extent from the exudate
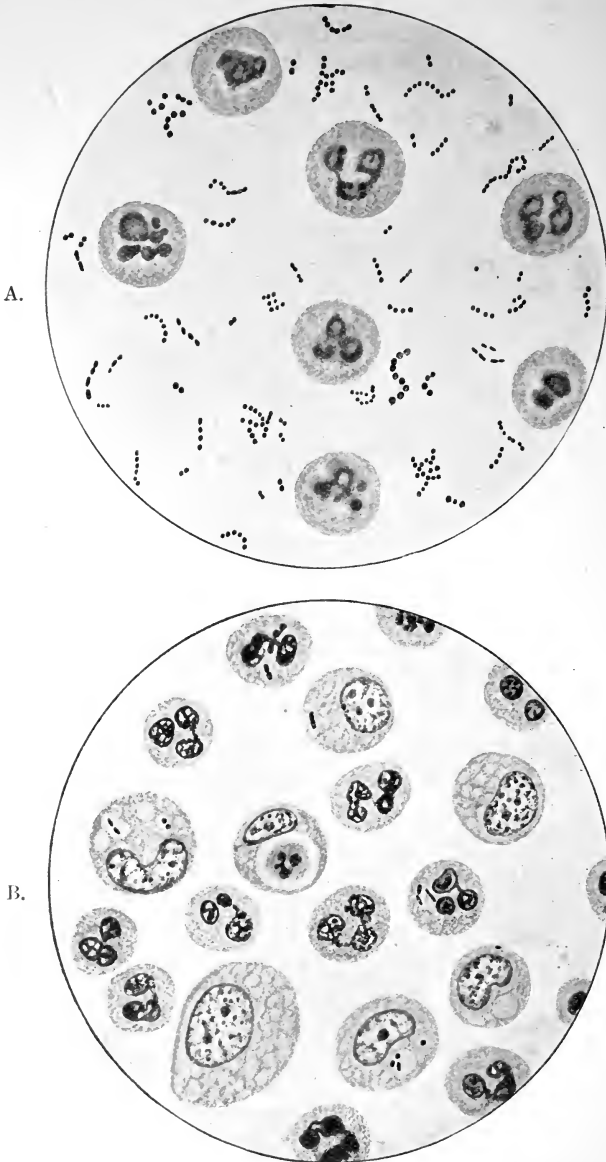
FIG. 53 (A and B). A, Fatal streptococcal peritonitis—no phagocytosis, faint staining. B, Film from a case of general peritonitis—successful phagocytosis, numerous mono-nucleated macrophages. (Wilkie, *International Clinics*.)

many of them undergo lysis, while great numbers adhere to the omentum. At the end of three or four hours the character of the exudate changes in two respects, viz. the bacteria are again much more numerous and the polymorphonuclear leucocytes are present in great numbers. Thereafter, unless the protective mechanism of the animal is paralysed by the virulence of the bacteria, the polymorphonuclear leucocytes continue to arrive in increasing numbers until the bacteria are overcome.

"When the animal's resistance is relatively high these polymorphonuclear leucocytes, or microphages—to use Metchnikoff's name for them—rapidly ingest the bacteria. If film preparations be made from the peritoneal exudate during this stage of active and successful phagocytosis the polymorphonuclears are seen to stain well, many of them contain ingested bacteria, and their nuclei are clear and well defined. In such a favourable case, few, if any, extra-cellular bacteria are to be seen. In colloquial language, the cells are obviously winning.

"When the animal's resistance is low or the bacteria are specially virulent, the polymorphonuclears do not appear in such large numbers, and, though some of them may contain bacteria, many show signs of degeneration, and extracellular bacteria are seen in the film (see Fig. 53).

"In cases where peritonitis has existed for twelve hours or more, and where the animal is going to recover, the peritoneal films are characteristic : numerous healthy polymorphonuclears are seen, some of them containing bacteria, but the striking feature of the film is the presence of the large mononucleated macrophages. Some of these cells may have ingested bacteria, some of them have engulfed one or more of the microphages. . . ."

"The appearing of the macrophages and the display of their phagocytic activity for microphages is invariably a favourable sign, and when in a given case the large mononucleated cells outnumber the polymorphonuclears and have ingested many of these cells, we realise that the process of repair is in full swing, and that recovery is assured. In such a case the exudate is usually thick and purulent, yet drainage of the peritoneal cavity is not only unnecessary but is meddlesome.

"Peritonitis, as we meet with it in the human subject, differs from experimental peritonitis in that it usually spreads from a local focus and is not immediately generalised. There are, however, a very large number of cases where the surgeon is called on to treat a free and diffused though not generalised peritonitis, and in this class of case an immediate and accurate scientific index of the relative strengths of the infection and the reaction is of great value. Certain common-sense precautions must be taken in using this form of examination. In the first place, it is obviously of no value in localised collections of pus which are walled off by peritoneal adhesions ; here the pus may be swarming with bacteria and recovery ensue. Nor is it of much value when applied to the reaction fluid in the peritoneal cavity surrounding a large walled-off abscess, for here the fluid may show healthy cells and few or no organisms, and the patient may yet die from toxæmia from the large localised purulent collection. If, however, the test be applied in cases of free diffuse peritonitis, and the drop of fluid for examination be taken from the general exudate, a very important and a very reliable index of what is happening may be obtained." [1]

When adopted drainage may be only temporarily effective, but it is certainly efficient in saving life. In many cases several small incisions are made by separating the muscular fibres. These may be made above the pubes, over each iliac fossa, and sometimes above the iliac crests in the loin (see Fig. 54). In some cases when the general infection is due to the rupture of an abscess in the pelvis, vaginal rectal drainage may be established (see Fig. 55). Split rubber tubes, each containing a wick of gauze, are inserted in the wounds already mentioned and left in situ for about three or four days. When the tubes are withdrawn the muscular fibres come together, so that there is no appreciable risk of hernia following. No tube is passed into close proximity to any closed perforation, for the

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[1] *Technique of the Examination.* "This is eminently simple and can be carried out by any theatre assistant or nurse.

"When a case of suspected peritonitis is to be operated on there should be in the theatre a microscope with oil-immersion lens, some glass slides, a platinum needle, a spirit-lamp, and some simple stain, such as thionine blue or polychrome-methylene blue.

"As soon as the peritoneal cavity is opened a drop of the escaping exudate is taken on the sterilised platinum needle, smeared on a slide, and dried over the spirit-lamp. The film is then stained for two minutes, washed, rapidly dried, and examined under the oil-immersion lens. While the preparation of the film must be deputed to an assistant or nurse, the examination and interpretation of it should, where possible, be done by the surgeon himself. The interruption of the operation for a few minutes to glance down the microscope is more than compensated for by the accurate knowledge which the operator obtains of the nature of the fluid with which he is dealing."
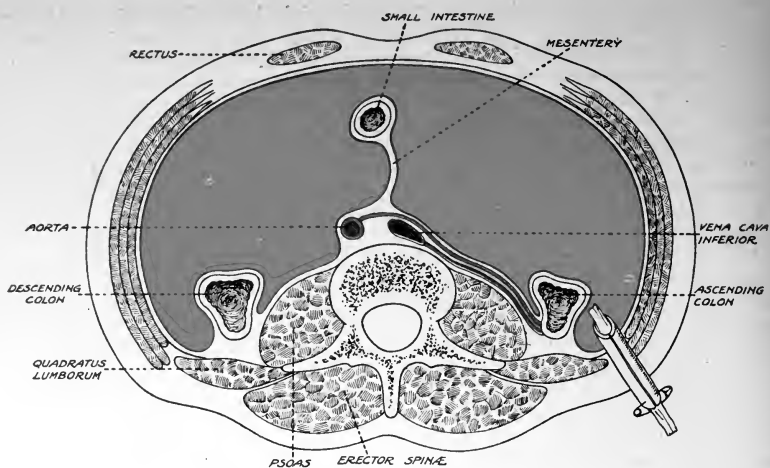
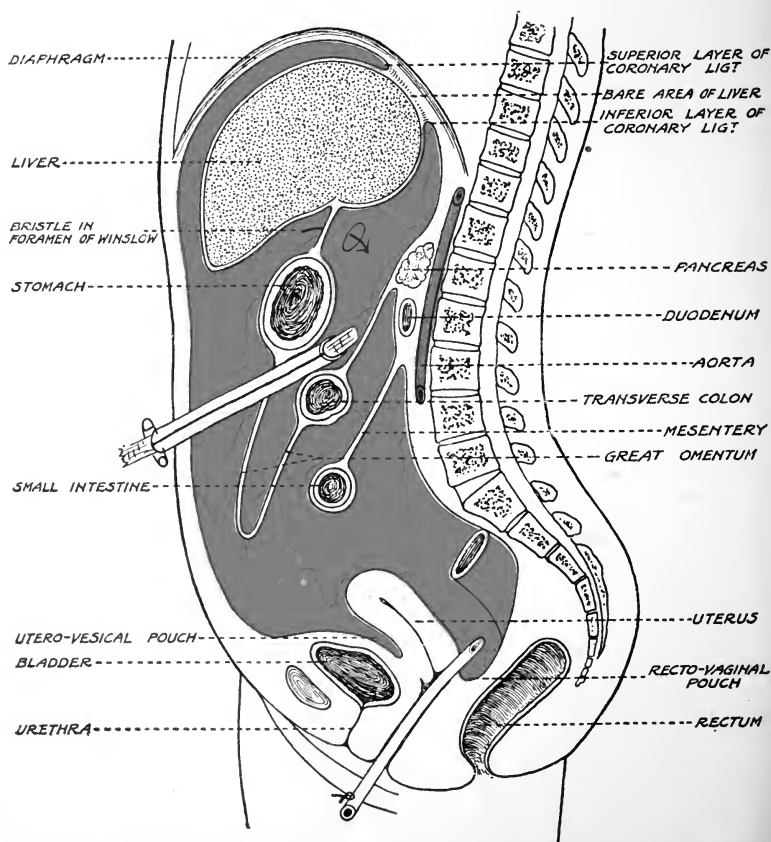FIG. 54. Drainage through the loin.

FIG. 55. Drainage of the general and lesser sacs for peritonitis. The upper tube is suitable for perforation of a gastric ulcer into the lesser sac. The vaginal tube is suitable for peritonitis of pelvic origin.

tube prevents that adhesion of the perforated viscus to the neighbouring parts which is so essential for the permanent closure of the perforation. In those rare cases, however, when it is impossible to close the perforation a tube must be placed near it.

The original incision is closed either entirely or in part, a tube being sometimes placed at one end. Whenever possible it is important to close the original wound entirely and to drain through supplementary valvular incisions as already mentioned.

Distension. In late cases when there is distension of the bowel, it is necessary to drain away the poisonous contents of the intestines and at the same time to relieve the distension and thus enable the intestine to regain its muscular power. In some cases the incision made with due precaution in the small intestine can be closed immediately after the distension has been relieved. In more severe cases a temporary enterostomy is quicker and affords more lasting relief. In many of these cases great relief is afforded by frequently washing out the stomach, which soon fills by regurgitation from the intestines. A rectal tube and repeated turpentine enemata relieve distension of the colon. The
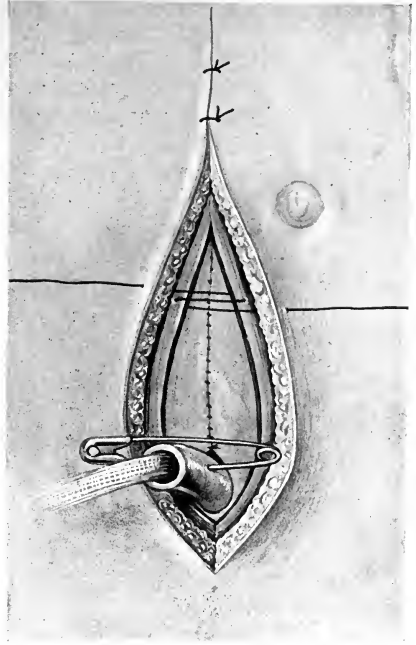

Fig. 56. Rubber tube with loose wick of gauze draining pelvis. The peritoneum has been closed above, and the rectus sheath is closed with " X " fishing-gut sutures.

sitting-up position is most important after the operation.

OPERATION FOR EARLY OR LOCALISED PERITONITIS

When the cause is fairly certain, which often happens in appendicitis and perforated gastric or duodenal ulcer, a local incision is made over the seat of infection. For appendicitis a gridiron incision is made over the appendix, and a vertical incision is made through the upper part of the right rectus for perforation of a gastric or duodenal ulcer. When the peritonitis is limited to the lower abdomen and the cause uncertain, as may often happen in a woman, a vertical incision is made below the umbilicus and the rectus is displaced either outwards or inwards. Through these incisions either the appendix or suppurating Fallopian tubes may be removed. Upon opening the abdomen the first step is to pack off the healthy part of the peritoneum, and the simplest and safest way to do this is to pass one or more gauze rolls in appropriate directions. One end of each roll is always clipped to the towels. When the disease is in the pelvis the packs are passed to both loins. Then the local disease is dealt with without fear of contaminating the general peritoneal cavity. In these early cases it is not necessary to irrigate.

It is much quicker and safer to absorb the effusion with gauze rolls. For instance, a pack is passed into the pelvis while the appendix or tube is removed. When the pack is removed at the end of the operation, the pelvis is quite dry and clean. When a localised peritoneal abscess is found, great care is taken to pack off well before it is opened, and to mop up all the pus and to clean the cavity out carefully with moist sterile gauze before proceeding to remove the cause, such as a diseased appendix or tube. When deliberately operating for a localised peritoneal abscess it is often possible to open this without invading the peritoneal cavity. This is all that is necessary in many cases, but when it is important to ascertain and remove the cause, and the patient's condition allows, it is much better to deliberately open the healthy peritoneum first and to pack this off very carefully before opening the abscess to clean its cavity, and then it is usually quite safe to proceed to remove the cause, such as a diseased appendix.

OPERATION FOR PNEUMOCOCCAL PERITONITIS

It is important to remember that this is a part of a general pneumococcal septicæmia. For instance, the lungs, pleuræ, pericardium, endocardium, or joints may be affected at the same time or just before. This makes the prognosis of the disease very grave. In some cases infection occurs through the intestine, especially the appendix, and the affection is then more local and less grave. Pneumococcal infection is always to be suspected, especially in children, when diffuse peritonitis with unusually rapid pulse and high fever develops without signs or symptoms of any local source of infection, such as appendicitis or perforated gastric ulcer. The history or presence of herpes, pneumonia, or pleurisy adds to the suspicion. In many cases, however, there are no means of telling the exact nature of the peritonitis until the abdomen is opened without finding any local source of infection. The peculiar character of the exudation may point to pneumococcal infection, which is confirmed by immediate bacteriological examination. Dr. W. F. Annand and Mr. W. H. Bowen[1] have recorded four cases of this rare disease, and they were able to collect 91 cases, including their own ; all these patients were children under the age of fifteen ; the disease is much less common in adults. In 30 cases the peritonitis was secondary to a lesion elsewhere, especially in the lungs and pleura. Primary infection had occurred in the throat or middle ear in several cases.

In 45 patients the peritonitis was considered to be primary, possibly due to infection from the intestines, especially from the appendix. In 44 cases there was such a rapid spread of the infection that it was impossible to decide upon any primary seat.

The pus is nearly always thick and odourless, and it may have fibrinous or jelly-like masses floating in it, and layers of greenish-yellowish lymph are deposited on the peritoneum and intestinal coils. The peritonitis may be localised or diffuse, sub-acute or acute. The sub-acute form generally starts acutely, but there is a great tendency towards the formation of circumscribed sub-acute abscesses, so that a diagnosis of tuberculous peritonitis is quite likely to be made. The acute form is generally mistaken for peritonitis due to appendicitis, unless a primary pneumococcal lesion is known to exist. The character of the pus

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[1] *Lancet,* 1906, vol. i, p. 1591.

and the absence of any discoverable source of the peritonitis and immediate microscopic examination should make the diagnosis clear during the operation.   A similar but even graver peritonitis sometimes occurs as a part of streptococcal septicæmia, and occasionally follows scarlet fever.

Treatment.   Localised abscesses should be incised and drained.   In the acute diffuse form the diagnosis will usually be made when the abdomen is opened for peritonitis of uncertain origin.   When the diagnosis can be made with anything approaching certainty, Cameron suggests that it may be better to defer operation until the septicæmia has subsided.   As it is the mortality of operations for diffuse pneumo-coccal peritonitis is very high ; so that it is reasonable to wait a while if the patient is very ill, and especially if there are signs of pneumonia, pleurisy, or pericarditis.

Bowen advises mopping out the pus, and closing the wound com-pletely if the pus be sweet ; but if the pus be evil smelling, indicating mixed infection, drainage should be adopted.

Irrigation of warm saline solution is quicker and more effective when there is diffuse peritonitis.   I should be inclined to leave a tube in the pelvis in every case, and von Bruns believes drainage to be necessary.

The prognosis.   The following Table from Annand and Bowen speaks for itself :

Variety of peritonitis	Number of cases	Number of cases operated on	Number of cases not operated on	Result		
				Re-covery	Death	Un-certain
Primary local	26	26	0	22	3	1
Secondary local	11	10	1	9	1	1
Primary diffuse	21	10	11	2	19	—
Secondary diffuse	19	5	14	3	16	—
Origin uncertain { Local . .	8	8	—	6	2	—
{ Diffuse . .	6	3	3	1	5	—
Total	91	62	29	43	46	2

" Forty-five of the 91 cases had encysted peritonitis, of which 44 were operated on, and of these 37 recovered and 6 died ; in 2 the result is uncertain.   The other 46 cases were of the diffuse variety, of which 18 underwent operation.   Of the 18 cases operated on 6, or 33·3 per cent., recovered, whereas all those not operated on died.   The one case of the local variety not operated on recovered by spontaneous evacua-tion of the pus.   The above Table shows that recovery occurred in 86 per cent. of those with the encysted form, whilst only 14 per cent. of the cases with the diffuse variety survived."

Rischbieth[1] records 57 cases ; of these 3 were adults, who all died, and 54 were children, of whom only 6 recovered ; in these the col-lection was localised.   Carmichael[2] reports 20 cases with 35 per cent. mortality.   Dr. Cameron[3] analysed 26 cases occurring at Guy's Hospital

[1] *Quart. Journ. Med.*, January 1911.   [2] *Brit. Med. Journ.*, September 18, 1909.
[3] *Proc. Roy. Soc. Med.*, 1912, vol. i, pp. 123–133.

between 1903 and 1912. Nineteen of the patients were females, and of these 15 were little girls between 5 and 15 years.

Twelve patients were submitted to immediate laparotomy; 9 of these died, 3 recovered, but the laparotomy performed at the onset of symptoms failed to produce immediate improvement. The patients passed through a long and critical illness, developed residual abdominal abscesses and recovered after the evacuation of the pus. Of 8 patients considered unsuitable for operation all died. On the other hand, 4 patients admitted after recovery from pneumococcal septicæmia with quiescent residual abscesses made good recoveries after operation.

It is probable that this form of peritonitis is more common than is suspected at present, and that a more general bacteriological examination of the pus in cases of peritonitis will prove this assertion.

CHAPTER IV

OPERATION FOR TUBERCULOUS PERITONITIS

IT is important to remember that tuberculous peritonitis is often associated with tuberculous disease of the mesenteric glands and intestine and that there may be serious tuberculous lesions elsewhere. Although the question of the advantage of operation in this disease has been much debated, there can now be little doubt that, in suitable cases, great benefit has often resulted from operation. It is still very difficult to determine the actual percentage of permanent cures, owing to the small number of cases that have been efficiently followed up. Dr. H. P. Hawkins,[1] from an examination of 100 cases treated consecutively at St. Thomas's Hospital, came to the conclusion that there is but little difference in the mortality whether operation is resorted to or not. Such slight difference as does occur is in favour of operation. The following figures, quoted by Sir Watson Cheyne,[2] are distinctly more favourable. In 1895 Roersch published 358 cases with the following results. The deaths immediately due to the operation numbered 32 ; deaths at a later period (within eighteen months) and due to extension of the disease, general tuberculosis, &c., numbered 51. In the rest of the cases improvement followed, and many were apparently cured. For instance, in 53 cases two years and upwards had elapsed since the operation, and the patients were apparently quite cured. According to these figures, improvement or cure therefore results in 75 per cent. of the cases operated on. As pointed out by Sir Watson Cheyne, this percentage is too high, since many cases relapse even after prolonged periods of apparent cure and, moreover, the successful cases are more likely to be published than the failures. Sir Watson Cheyne, as a result of his own valuable experience, considers that improvement takes place in about 50 per cent. of the cases, and he states, moreover, that in many the rapid improvement after operation was most remarkable. He says : "I must confess that I have been surprised at the recovery of some of these cases. On opening the abdomen one finds tubercles everywhere, the intestines protrude from the wound and are seen to be red, inflamed, and covered with tubercles, some of them sometimes of considerable size, the abdominal cavity feels like a bag of rice ; and yet in these cases recovery may follow. In two cases in which I made a very bad prognosis after the operation, on account of the size and the number of the tubercles scattered all over the intestines and abdominal cavity, recovery took place rapidly, and apparently completely."

Halstead[3] states that over 1500 cases of tuberculosis of the peri-

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[1] *St. Thomas's Hospital Reports*, 1892.　　　[2] *Lancet*, vol. ii, 1899, p. 1725.
[3] *Amer. Med.*, January 31, 1903.

toneum, treated by operation, have been recorded. The percentage of recoveries in the ascitic form is from 40 to 50 per cent. and in the adhesive form about 25 per cent. After five years' freedom from recurrence the disease may be considered to be cured.

Lobsingier [1] states "that statistics show 50 per cent. cured and 25 per cent. greatly benefited after the lapse of from four to five years from the date of the laparotomy." Death often occurs from tuberculous lesions in other parts of the body.

In opening a discussion upon this subject at a meeting of the British Medical Association in 1911, Dr. Rolleston [2] discussed the indications for operation. As an experienced physician who has given the subject much attention and has studied the literature extensively, his views upon surgical treatment are valuable, and I therefore give them in full.

" It may be stated as generally agreed (1) that operation is contraindicated in generalised or widespread tuberculosis, and therefore in infants under 12 months of age and in patients with signs of pulmonary tuberculosis. (2) That it is unnecessary in the fibrous and adhesive forms in the absence of any urgent symptoms of intestinal obstruction. (3) That it is necessary in cases of abscess formation and in intestinal obstruction. It must be remembered that the last complication may be simulated by the onset of tuberculous meningitis. The question of operative interference therefore concerns cases of ascitic abdominal tuberculosis. The much-debated question of operation may be introduced by a brief consideration of its mode of action. It has been supposed that operation reduces the feeble vitality of the peritoneal tubercles so that they undergo involution and death. More recently the explanation has been put forward that peritoneal tuberculosis being a local infection the opsonic index of the ascitic effusion is lower than that of the blood ; hence after the removal of the ascites there occurs a fresh effusion which is of a higher opsonic index, and therefore has a curative action on the local tuberculous process (White). If this is true, simple paracentesis should be as effective as laparotomy. The advantage of laparotomy, however, over simple tapping is that a local focus of tuberculosis which may give rise to re-infection and relapse after partial or apparent cure may thus be detected and removed (Mayo). In this connection it is important to get some estimate of the frequency with which such a focus is present and can be removed. In Mayo's 26 cases in which the Fallopian tubes were removed, 25 recovered permanently, and in 7 of these simple laparotomy had previously been performed from one to four times for the cure of tuberculous peritonitis. On the other hand Stone, who holds a brief for the hygienic as opposed to the surgical treatment, in 122 cases of tuberculous peritonitis of all ages did not find a primary focus in the Fallopian tubes or appendix in any case. Undoubtedly primary tuberculosis of the Fallopian tubes, though common in women, is very rare in young girls ; Murphy quotes Maas as having, after a careful search, only been able to collect 8 cases. As was shown by Murphy's experiments on monkeys, the Fallopian tubes rapidly become infected secondarily in tuberculosis of the peritoneum. In 23 cases of generalised tuberculous peritonitis in female children, 9 showed tuberculous salpingitis (Still). According to Goodall 99 per cent. of the cases of tuberculosis of the Fallopian tubes are secondary, though in from 30 to 50 per cent. of these cases the primary

[1] *New York Med. Journ.*, Dec. 5, 1903.   [2] *Brit. Med. Journ.*, Sept. 2, 1911, p. 473.

focus is not obvious. But secondary infection of the Fallopian tubes may give rise to very considerable enlargement, and the tuberculous focus thus produced, though not primary, may set up reinfection of the peritoneum and so require removal. In a girl aged 9 the Fallopian tubes infected secondarily to tuberculous peritonitis were the size of the index fingers of an adult, and were removed ; ten years later she was in good health (Murphy). Removal of tuberculous glands may be very difficult, and an attempt to do so may leave the patient worse off than before. The argument in favour of laparotomy that a removable tuberculous focus may thus be found is, on the whole, valid, but not very strong.

" It is generally agreed that the ascitic cases do well, whether they are operated upon or left alone. The following questions therefore arise : (1) Are the results better in the operative cases than in those which are treated medically ? (2) As some cases begin as ascites and go on to the ulcerative or plastic stages, is there any reason to believe that early laparotomy will prevent this sequel ? If so, operation would be justified. On these points statistics would be of value.

" Although, as already mentioned, statistics on tuberculous peritonitis usually deal with all forms of the disease, it is desirable to quote some dealing solely with the disease in children. Faludi has drawn up Tables showing the percentages of cures in parallel series of cases of tuberculous peritonitis in children operated upon and not operated upon. The authors he quotes are Cassel, Monti, Pic, Schmitz, Schramm, and Sutherland, who all give parallel series of cases operated upon and not operated upon. The divergence in these statistics is considerable. Schramm found 80 per cent. of cures among the operated cases and 64 per cent. among the non-operated ; Pic observed recovery in 74 per cent. of the operated cases and in 5 per cent. only of the non-operated ; Sutherland observed recovery in 50 per cent. of the operated cases and in 81 per cent. of the non-operated. By adding up all the operated cases we get 88 cures, or 70·4 per cent., in 125 cases, as contrasted with 51 cures, or 33 per cent., in 156 cases not operated upon. *The question of operation on ascitic cases may be fairly summed up in the statement that it should be tried after hygienic and medical treatment has been given a fair trial for a month or so without any definite benefit.*

" Simple paracentesis is not often necessary and is seldom practised. After removal of some of the fluid, injections of various kinds through a cannula have been employed ; thus sterilised air, oxygen (Schulze), isotonic salt solution, adrenalin (Wynter), have been reported to give good results. The injection of camphorated naphthol is a dangerous procedure (Guinard)." I have no experience of any of these methods.

From the point of view of surgical interference in this disease, the following classification of the principal types of the affection is important.

A. *The ascitic.* Here the inflamed peritoneal sac and its contents are studded, as far as can be seen, with hosts of grey " sago grain " granulations, tending to become confluent. Caseation is absent, or only present in a very early stage. The fluid is rarely sero-purulent. Adhesions are absent or insignificant. The fluid here may be localised and encysted. The ascitic form may come on very insidiously, and is not uncommonly the subject of a mistake in diagnosis.

B. *The caseating and purulent.* Here caseation is always present ; the amount of pus varies. Usually this is abundant, and is too often

encysted, imperfectly, in many collections. More rarely the caseation is dry, unattended with effusion, the intestines being matted together by adhesions which are themselves infiltrated and caseating. If the adhesions are separated, hosts of small loculi present themselves, with scanty fluid, usually purulent. The caseating is the variety which we see so typically in wasted children with hectic, vomiting, and diarrhœa. In some cases secondary infection of local collections from adherent intestine is indicated by high fever with rapid increase of swelling. Sometimes the abscess contains gas and may be very deceptive. This generally calls for immediate operation.

C. *The fibrous.* This is the rarest, but a favourable variety. The bacilli are probably few. Caseation is absent, and any fluid present serous and scanty. In this form and the second, if such parts as the omentum and mesentery are densely infiltrated, a new growth may be closely simulated.

The amount of improvement after operation that may be expected in any case of tuberculous peritonitis depends chiefly upon two considerations: (1) The stage which the disease has reached, and (2) the type of disease that is present.

(1) *The stage of the disease.* It is most important that the operation should be undertaken before the vitality of the patient has been much diminished by general failure of nutrition, hectic, or tuberculous disease of other parts, &c., in order that the effect of the operation itself may be quickly recovered from. For in the advanced stages of the disease the shock alone of the operation may be sufficient to bring about a fatal result, or in any case to hasten the end. Sir Watson Cheyne's [1] advice on this point may be quoted: " I should say that in practically all cases where improvement does not follow under medicinal treatment after a reasonable time, say in from four to six weeks in acute cases to from four to six months in chronic cases, the abdomen should be opened whether there be ascitic fluid or not. The operation may do good in cases where it is least expected to do so, and it is but seldom that it can do any real harm. Do not in any case allow the patient to go downhill too much, otherwise one cannot expect good results to follow, and it is fair neither to the patient nor to the surgeon."

(2) *The type of disease.* The most favourable cases are those belonging to Class A, where there is free fluid and the adhesions are few. Class C is also favourable for operation, but Class B is distinctly unfavourable. Here the operation may do much harm, for adhesions are numerous and the wall of the bowel often much thinned. The result of manipulation is frequently the production of one or more fæcal fistulæ, with perhaps the setting up of acute suppuration. Improvement has, however, resulted even in some of these cases, for Sir Watson Cheyne points out that there is no class of cases in which some improvement has not taken place, so that it is very difficult to absolutely exclude any case from operation.

Mr. Wright,[2] from his own experience and information obtained by Mr. Jefferson, who traced many of Mr. Wright's patients, concludes that :

" (1) Probably not much more than half the cases would live to grow up, for of those who recover for a time a large proportion die of tuberculosis in some form within a few years, though the immediate operative mortality is of course very small.

[1] *Loc. supra cit.*　　　　　[2] *Loc. supra cit.*, Brit. Med. Assoc. Meeting, 1911.

" (2) There is no hard and fast line between ascitic and plastic cases, either as a matter of morbid anatomy or of operative treatment, or of mortality. But operation is simple where there is much fluid, and may be impossible in obliterative cases.

" (3) Tuberculous mesenteric glands may be safely removed and in some cases certainly should be removed.

" (4) The rôle of surgery in tuberculous peritonitis is rather to remove secondary troubles, such as obstruction, and to get rid of noxious collections of fluid and local foci of tubercle, rather than to play any great part in the prevention or cure of the disease as a whole.''

Operation. Usually it is best to open the abdomen near the middle line below the umbilicus, taking care to make a valvular opening by displacing the right rectus outwards. Through this incision the cæcum, Fallopian tubes, the ileum, and the mesenteric glands can be easily examined and dealt with, and the wound, when completely closed, is not likely to be followed by hernia. The escape of fluid may be facilitated by turning the patient on to his side, and the peritoneum thoroughly dried by means of gauze rolls passed in various directions and clipped to the towels. Where the fluid is loculated by means of adhesions, the separate loculi may be made to communicate by gently breaking through such of the adhesions as may be necessary for this purpose. No extensive disturbance of the adhesions beyond this is either necessary or advisable. In some cases an obvious primary seat, such as a tuberculous Fallopian tube, cæcum, appendix, or caseous gland, may be discovered. This should be removed should the condition of the patient be such as to admit of the necessary prolongation of the operation, and if the adhesions are not so numerous as to render the procedure very dangerous. In some cases, however, in which such a primary focus is found, it will be firmly fixed to other important structures or embedded in a mass of adhesions ; in such cases the wiser course will generally be in making no attempt at a radical operation, but in resting content with letting out the ascitic fluid as described above. When the condition of the patient will not allow the resection of a tuberculous cæcum short circuiting should be performed, the ileum being divided about four inches from the cæcum, the lower end invaginated, and the upper end inserted in the sigmoid colon. There is rarely anything to be gained by either washing out the abdominal cavity or by drainage, so that as soon as all the fluid has escaped the abdominal wound should be closed in over-lapping layers, and the dressings applied.

In January 1910, an undergraduate, aged 20, complained to his tailor, saying that his clothes did not fit him properly. Then his friends noticed that his abdomen was getting larger, and he had a little diarrhœa and wasted a good deal. He returned home in the middle of March and saw Dr. Lipscomb of St. Albans and Dr. Lauriston Shaw in consultation. A diagnosis of tuberculous peritonitis was made and an operation was advised. I performed this at the middle of March 1910. The patient was then thin and cyanosed probably owing to the enormous distension of his abdomen interfering with his respiration. The lower part of the right rectus was displaced outwards. The parietal peritoneum was very thick and there was considerable œdema of the sub-peritoneal tissues. There were no adhesions. A very large amount of dark yellowish clear fluid escaped. The parietal peritoneum and the small intestines were studded with tubercles, some of which were caseous. The intestines were very vascular, partly due to the release of pressure by the sudden escape of the liquid. The cæcum was bound down, and the appendix was found to contain a calculus and to be adherent behind the cæcum and the lower end of the ileum. It was thought wise to remove it. There was some difficulty in getting the

cæcum into the wound, and in separating the appendix from dense localised adhesions. The calculus was in its basal third. Its distal two-thirds were firmly bound down and the lumen was almost obliterated. The extremity was fibro-caseous, and on microscopic examination this proved to be tuberculous. There ·were a good many moderately enlarged mesenteric glands, and at one part the small intestine was thickened and rather kinked towards the mesentery. An ulcer was found to be present at this spot. The cæcum was not thickened. The fluid was all mopped away and a tube was left for twenty-four hours at the lower angle of the wound which was otherwise closed by means of catgut for the peritoneum and mass salmon gut sutures for the remaining layers. The patient stood the operation well, but the fluid was let out rather slowly. Once when a gush of fluid escaped the pulse became rather feeble until the flow was regulated again. Afterwards the patient lived an open-air life, and although some fluid collected in the abdomen again, his general and local conditions improved so that now three years afterwards he is quite well and strong and leads a very active life.

If on opening the abdomen the case is found to belong to Class B, great care and gentleness must be used in opening up and dealing with abscess cavities, for the walls of the intestines are frequently thinned and softened by the disease, so that any undue roughness in handling is extremely liable to result in rupture of the bowel, either at the time or later, causing fæcal abscess or fistula. No attempt should be made in such cases at eradicating the disease, but abscess cavities may be treated as tuberculous collections elsewhere are treated, by evacuating the contents, gently swabbing out the cavity with sterilised gauze, and then closing the cavity. If the pus is, however, found to be fæculent owing to infection from the bowel, the abscess must be either drained with a tube or stuffed lightly with gauze.

CHAPTER V

OPERATIONS UPON THE STOMACH

Preparation of the patient. In Chapter I a full account is given of the usual preparation of patients for an abdominal operation, and also of the general plan of after-treatment after these operations. Here it is necessary to lay stress upon some points which are of special importance in gastric surgery. Except in urgent cases the patient should be at rest and preparing for the operation for at least three days. In many cases it is advisable to prepare him for a week, for it is of great value to carry out radiographic and chemical investigations and to get the mouth as free of infection as possible, and to sterilise the contents of the stomach and upper part of the intestines. When there
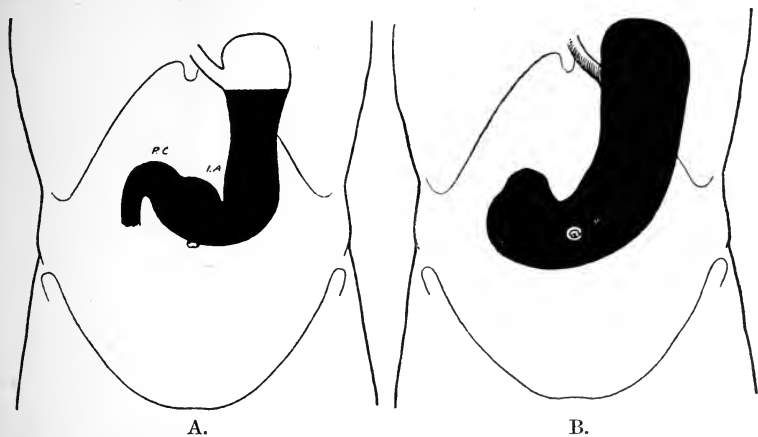
FIG. 57. Bismuth radiograms of the normal stomach with the patient standing. A, Moderately full. B, Distended (Dr. Hertz). Note that the position and shape are very different from those observed in the supine cadaver. Note also the division into cardiac and pyloric portions. An appreciation of the limits of normality is very important here.

is pyloric obstruction with stasis of the gastric contents or growth without obstruction, the gastric contents are foul and infective. It is therefore important to wash out the stomach carefully with large volumes of boiled water twice a day for at least three days. The last washing out is performed about two hours before the operation. Only sterilised liquid food, such as boiled milk or soup, is given during the last two days. Apart from stasis or growth, it is rarely necessary to wash out the stomach. Attention to the mouth and sterilisation of food is sufficient. With pyloric obstruction the colon is often full of scybala; therefore laxatives are given for several days before operation, and the colon

is washed out with soap and water, after six ounces of olive oil has been left in the rectum for several hours. No purgative is given the night before the operation. These patients are often thin and very deficient in fluids. One pint rectal salines night and morning are therefore of great value for several days before the operation. The last one is given two hours before the operation. When the operation is likely to be prolonged saline solution is run into the axillæ before, during, and after the operation. Open ether, following morphia (one-sixth of a grain) and atropine (one-hundredth of a grain), is usually the best anæsthetic for these patients.

AFTER-TREATMENT

In the after-treatment it is important to keep the patient in the oblique position so that drainage may be facilitated and pulmonary complications avoided. Thirst is especially severe and trying in these patients, who usually crave for water as soon as the effects of the anæsthetic have passed. Water at first, one ounce at a time, should be given frequently and the amount rapidly increased. It cannot possibly do any harm for after careful sewing the fear of leakage is groundless. The rectum is washed out every morning and a little turpentine is added to the enema if there is much flatulence. For the first two days one pint of saline solution is given by the rectum twice a day. Tea, and milk and water, in the proportion of one of milk to two of water, is given freely during the first twenty-four hours. After this time ordinary milk, milk and egg, soup, cocoa, Benger's food, lightly boiled eggs, and milk puddings are given. Solid food is not given quite so early after gastric operations, usually not before the end of a week. Then fish, sweetbread, thin bread and butter, minced meat, and minced chicken are given. Coarse vegetables, pastry, and raw fruit are irritating and valueless, and are not given. The bowels generally open spontaneously about the third day. In any case an aperient is not given until the end of the third day, when a dose of castor oil or calomel is given. Usually the patient gets up on a couch on the tenth day. After operations for non-malignant disease the patients often get up earlier. For the other cases a convalescence of at least five or six weeks is desirable and a careful diet must be observed for several months after the operation, in order to ensure a complete and permanent restoration of health.

ANATOMICAL POINTS

Our conceptions of the shape and position of the stomach have been greatly modified by frequent laparotomies, and especially by radiographic examinations. The cardiac orifice and the pylorus are almost fixed points, but the other parts vary greatly in size and position within the limits of health. The cardiac portion is a passive sac, while the pyloric segment shows active peristalsis. The position of the stomach varies greatly with the attitude of the patient (see Fig. 57). The lymphatic drainage and blood-supply are shown in Figs. 117 and 118.

CHAPTER VI

GASTROTOMY

Indications. An opening is made into the stomach for the removal of foreign bodies which will not pass through the pylorus, such, for instance, as forks, coins, or masses of hair. Increasing pain, vomiting, emaciation, and failure of the foreign body to pass in a few days are the general indications. An X-ray examination should always be made to prove the presence and locate the position of the foreign body. In a few cases the operation is required for the removal of foreign bodies impacted low down in the œsophagus or for exploring the interior of the stomach.

Operation. A. **For the removal of foreign bodies from the stomach.** A vertical incision at or near the middle line is generally the most convenient. It extends from the ensiform cartilage to the umbilicus. The abdomen is opened, the edges of the wound are carefully protected with pads, and the exact site of the foreign body is made out. If this be pointed great care is taken not to let it damage the stomach during the manipulations. In such cases the abdominal wound must be free, so that the surgeon may see what he is doing. In the case of such a body as a fork the blunt end must first be found.

When the surgeon has decided where to open the stomach, he brings this part out of the wound and packs sterile gauze all around and behind it. Whenever possible he applies a clamp behind the foreign body to prevent bleeding and leakage, and to retain the pouch containing the foreign body outside the abdomen.

When it is impossible to use clamps owing to the large size or awkward shape of the foreign body, a vertical incision is made through the anterior wall of the stomach, and all bleeding vessels are at once tied. The body is next extracted with suitable forceps or a scoop care being taken to avoid damage of the stomach, and to prevent any blood or mucus escaping into the parietal wound or peritoneal cavity.

After the removal of the foreign body, if the stomach contains much mucus or blood, this may be removed by gentle sponging. When it is necessary to examine the interior of the stomach very carefully a transverse incision is made, and two fingers are passed behind the stomach through an opening in the gastro-colic omentum. These fingers can bring any part of the posterior wall of the stomach into view, or even protrude it through the incision in the anterior wall. The aperture in the stomach is closed with a continuous suture which pierces all the coats, and inverts the edges of the wound after Connell's method. This is reinforced by a continuous Lembert suture. The packs are removed and the parietal wound is closed.

B. **For removal of bodies,** *e.g.* **tooth-plates, impacted in the lower part of the œsophagus.** These cases, though rare, with the perfection

of the œsophagoscope, are so difficult as to call for some remarks here. Professor Richardson, of Harvard University, first brought forward a very successful case of this operation.[1] A plate carrying four teeth had been impacted eleven months in a patient aged 37. Numerous attempts had been made to remove it through the mouth. The plate was successfully removed by gastrotomy, by an incision six inches long parallel to the lower margin of the left ribs. The following interesting details are given :

Determination of the site of the foreign body. In an individual of average height, and with a neck of ordinary length, the distance from the incisors to the diaphragm is fourteen and a half inches. All parts of the œsophagus are accessible to the finger either by gastrotomy or external œsophagotomy. With the right forefinger introduced by œsophagotomy and the left by gastrotomy it was found possible, not only to make the fingers touch, but in many cases overlap. But these results are only approximate, as it would not always be possible to do both operations on a patient. It is possible to reach with the left hand three inches above the cardiac opening, *i.e.* the length of the left middle finger. From above, through the wound in the neck, one cannot reach quite so far on account of the sternum and clavicle. Allowing in the average neck one and a half to two inches from the cricoid cartilage to the lowest point of the wound in the œsophagus, we have the average distance from that incision to the cardiac opening of five and a half or six inches. If the obstruction be less than six inches from the cricoid, an attempt should be made to remove it from above ;[2] if more than this, or thirteen inches from the teeth, gastrotomy should be performed. The incision that, on the whole, is recommended is oblique, one inch below and parallel to the left costal margin. The left rectus is divided and the incision is similar to the one used on the right side for gall- stones. Packs of gauze are carefully placed to isolate the field of operation. The stomach being drawn up into the wound, it is most essential to put the lesser curvature on the stretch, so that it makes a straight line to the diaphragmatic opening. The incision in the stomach wall must be far enough to the right to allow the passage of forceps along the sulcus between the anterior and posterior walls of the stomach, made tense as above. If the instrument is brought obliquely to this groove and passed upwards, all the time being pressed gently against the straightened lesser curvature, it will glide into the œsophagus every time with the greatest ease. The opening in the stomach should be first large enough to admit forceps ; if these fail, it must be enlarged transversely to admit two fingers, and the whole hand introduced, into the abdomen. The anterior wall then invaginates in front of the hand as the fingers seek the œsophagus.

The following case of Mr. Jacobson was difficult owing to the way in which the tooth-plate was jammed above the cardiac orifice. While such cases are rare, they are most important, on account of the numerous difficulties which they present.

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[1] *Lancet*, 1887, vol. ii, p. 707.
[2] Mr. Fullerton (*Brit. Med. Journ.*, May 7, 1904) performed œsophagotomy and removed a halfpenny which had been impacted for seven months opposite the third and fourth dorsal vertebræ, and four and a half inches below the wound. The wound was closed by deep and superficial sutures of catgut, and the child, æt. 7, recovered.

E. W., aged 44, was sent to me at Guy's in May 1889, having swallowed a vulcanite tooth-plate, which "stuck in his throat." The plate originally carried seven, but now only two teeth. A medical man whom he saw at once pushed the plate down with a bougie. An emetic which had been given then acted and brought up some blood. The patient complained of constant pain in the epigastric region just below the xiphoid cartilage, and in his dorsal vertebræ. Swallowing was painful, and so was eructation of gas, though this gave relief. Patient was able to swallow food quite well. He was not troubled by vomiting. A bougie could be passed into the stomach, but just before it entered it rubbed over a foreign body. The body did not yield in the least to any force which I thought it justifiable to use with the bougie. On June 11 I operated as follows :

The stomach having been washed out with dilute boracic acid, an incision three inches and a half long was made, parallel with the linea alba, commencing on the level of the xiphoid, and about an inch to the left of it. The rectus, the sheath being opened, was split with a steel director. The stomach was very small and pale. Sponges having been packed around, it was opened, with scissors, just to the right of the cardiac end, and as high up as possible. The opening was about a quarter of an inch long. Three small vessels sprang, and were tied. The exploring finger detected the body imbedded just above the cardiac orifice. The mucous membrane around felt pulpy and swollen. Numerous forceps were introduced by the opening, and then along the lesser curvature, but, though the body was repeatedly seized, I was quite unable even to loosen it. This was due to its not presenting any projecting points and to the swelling of the mucous membrane around. I next enlarged the opening in the stomach as so to introduce my hand, but, though with the tip of the middle finger I was able to reach the plate, I was unable to dislodge it. Mr. Durham and Mr. Davies-Colley also tried, with a like result. Moreover, to steady it, Mr. Tuddy was good enough to keep the end of an œsophageal bougie pressed against it from above. I closed the lower two-thirds of the wound in the stomach with Lembert's sutures of fine silk, and stitched the remaining part to the upper part of the parietal incision, so that other forceps might be tried later on. The patient, however, never rallied completely, and sank about forty-eight hours afterwards. At the post-mortem examination the coronary arteries were found in an advanced stage of atheroma. There was no peritonitis or escape of gastric contents. The mucous membrane near the cardiac orifice of the stomach presented a ragged appearance dating to the prolonged manipulations. The plate was very firmly fixed in the œsophagus, one inch and a half above the cardiac opening.

M. Bluysen[1] performed gastrotomy and removed a denture which had been swallowed a fortnight earlier, and had become impacted near the cardiac orifice. Forceps having failed, the index finger was introduced into the lower end of the œsophagus, and served to hook and remove the plate.

C. **For dilating strictures of the œsophagus from below.** Where non-malignant strictures low down in the œsophagus resist dilatation from above, and the patient is losing ground, the stricture may be attacked from below in one of the following ways :

(1) *By gastrotomy*, the opening being closed at the same time. Professor Loreta, of Bologna, operated on the first case in 1885.[2]

The patient, aged 24, had swallowed caustic alkali. Attempts to dilate the stricture by bougies were unsuccessful, and at last it became impossible to pass any instrument. The point at which the sound was arrested seemed to correspond with the fourth dorsal vertebræ. The patient was entirely unable to swallow, and emaciation had become extreme. Eleven months after the injury an incision about five inches long was made from the xiphoid cartilage downwards and to the left. Some difficulty was met with in finding the stomach, owing to its contraction and the way in which the liver overlapped it ; but at length the operator succeeded in drawing the greater part of the stomach out of the wound, and a longitudinal incision was made through its walls between the two curvatures, having its upper end as near the cardia as possible. The next step was to find the orifice of the œsophagus, in

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[1] *Lancet*, 1906, vol. i, p. 192.
[2] An excellent summary of Prof. Loreta's cases is given by Mr. Holmes (*Brit. Med. Journ.*, Feb. 21, 1885).

order to introduce the dilator ; but this involved considerable difficulty,[1] and the search was interrupted by a considerable quantity of bile, which regurgitated from the duodenum into the stomach. At length, by searching with the left index finger between the under-surface of the liver and the small curvature of the stomach, the end of the œsophagus was found. Then the distended stomach was kept drawn down by an assistant while the operator introduced a dilator (something like that of Dupuytren for lithotomy). The wound was then sewn up and the stomach returned. The patient rallied well, and in six hours swallowed some soup, with the yolk of an egg, to his great joy, as for twelve months he had been unable to do more than swallow mouthfuls. Recovery is stated to have been complete.

Mr. Kendal Franks has related an instructive case of the same kind : [2]

Here the whole of the right hand was introduced into the abdomen, and the index finger into the stomach through an opening an inch long situated about midway between the curvatures and the orifices. As the finger could only just reach but not dilate the stricture, an Otis's dilating urethrotome (the blade having been removed) was guided by the finger into the stricture, screwed up, and withdrawn fully expanded. After this had been done both laterally and antero-posteriorly, an œsophagus bougie could be easily passed through the stricture from above. The wound in the stomach was united with two continuous sutures, one uniting the mucous membrane, the other, by Lembert's method, the peritoneal coat. The patient made a good recovery. Large sized bougies could be passed without difficulty or pain.

It is clear that the above method may be resorted to with great benefit in non-malignant strictures low down in the œsophagus, where the dilated condition above the contraction makes it very difficult to hit this off with a bougie.

Cardiospasm, before its pathology was well understood, has been satisfactorily treated in a similar way, but the rubber bag dilator passed through the mouth is much safer and better and rarely fails. For obstinate diffuse dilatation of the œsophagus Lambert [3] successfully performed œsophago-gastrostomy (see Fig. 58).

(2) By gastrostomy. This, while rendering manipulations safer in a measure, cripples the surgeon's movements, as it will be impossible, however much the fistula be dilated, to get the finger passed through it anywhere near the stricture in the œsophagus.

Instrumental dilatation can alone be made use of through a gastric fistula, and for this reason the method by two stages is inferior to the other. It has been most ingeniously used under the following circumstances :

In 1889, Hagenbach,[4] directed a patient with a non-malignant stricture of the œsophagus to swallow a small shot attached to a long thread. This was drawn out of the stomach through a fistula, and a long silk thread fastened to it and drawn up through the mouth. To the lower end a bougie was tied, and increasing sizes were daily drawn through the fistula.

Dr. R. Abbe, of Newport,[5] advises what he calls the " string " method in the treatment of dense fibrous strictures. A gastrostomy having been previously performed,[6] a small gum-elastic bougie is guided through

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See the directions given at p. 96.   [2] Ann. of Surg., vol. i, 1894, p. 385.
[3] Lambert, Surg., Gyn. and Obst., January 1914.
[4] Correspondenzblatt Schweizer Aerzte, No. 5.
[5] Ann. of Surg., vol. i, 1893, p. 489.
[6] In this and the preceding instance the gastrostomy opening should be placed as high up as possible. In his case, Dr. Abbe opened the œsophagus near the root of the neck as well as performing a gastrostomy.

the stricture from below up into the mouth, and a stout silk ligature passed in the same way. This silk being see-sawed backwards and forwards, the stricture is felt to yield, and larger bougies can then be passed.
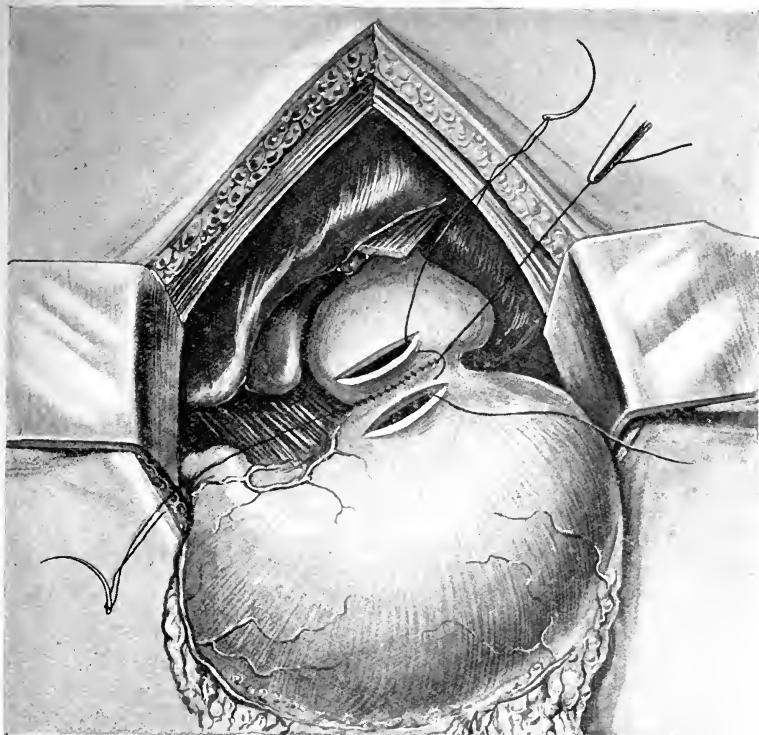

FIG. 58. Œsophago-gastrostomy. The dilated lower end of the œsophagus is exposed through the diaphragm and joined to the stomach as in gastro-gastrostomy with a small cardiac pouch. (After Lambert, *Surg., Gyn. and Obst.*, January 1914.)

Mr. Dunham [1] has devised a simple and ingenious way of getting a thread through a stricture of the œsophagus. He uses " an ordinary drinking tube, a glass of water, and a piece of black silk thread. The tube is threaded so that one end of the thread is at the mouth end of the tube. The patient then drinks through the tube. The thread is carried up the tube and on into the œsophagus by the current of water. More thread is fed into the water as it disappears up the tube care always being taken that it is not fed in too rapidly. When several feet of thread have been thus washed down the lower portion of the thread may be fished out of the stomach by means of a bent probe, passed in at the gastrostomy opening." In some cases this method may fail from want of co-operation on the part of the patient, and the thread may then be introduced through a funnel and rubber tube, the latter being passed into the pharynx or œsophagus. Once the thread has been introduced, larger ones will follow, and these can be used as suggested by Abbe. Some rubber tubing, kept upon the stretch by traction upon a string attached to each end of it, can be introduced, as suggested by Curtis. This effects dilatation very rapidly. and larger ones can be introduced until biconical French bougies can be used with ease, and the gastrostomy wound closed

[1] *Ann. of Surg.*, vol. xxxvii, 1903.   *Ann. of Surg.*, vol. xxxi, p. 358.

Dr. Dowd [1] records a very interesting and successful case of simple stricture near the cardiac end of the œsophagus, which was impermeable from above, and also from the stomach. Dunham's method of introducing a thread was tried, and failed. Kelly's cystoscope tube was used to locate the cardiac orifice from below, and to conduct bougies to the orifice, but the bougies would not pass. Dunham's plan was tried again, and proved successful, The stricture was dilated by the methods of Abbe and Carter, and within two months large (No. 28) bougies could be passed with ease, and ordinary food partaken of. The gastrostomy wound had been dilated for the introduction of the cystoscope, and leakage therefore occurred, so that it became necessary to close the fistula by an operation.

[1] *Ann. of Surg.*, vol. xxxix, 1904, p. 272.

CHAPTER VII

GASTROSTOMY

An opening is made into the stomach for introducing the food directly into it. It is important to make the opening valvular to avoid leakage of gastric juice, which makes the skin raw and burning so that life becomes a misery.

Indications. (1) Certain cases of malignant stricture of the œsophagus. (2) Cancerous disease of the pharynx; and, in a few cases, malignant disease of the tonsil or back of the tongue not admitting of a radical operation. (3) Carcinoma of the cardiac end of the stomach. (4) Cicatricial stricture, whether traumatic or syphilitic. It has been performed for cardio-spasm, but dilatation with the rubber bag is much better (Plummer).[1]

The first of these, from its frequency, requires separate notice:

(1) *Malignant stricture.* Here several points call for attention. Amongst the chief are: (*a*) the choice between the use of œsophageal tubes and gastrostomy; (*b*) the mortality of the latter operation; and (*c*) the best date for performing it.

The following remarks by Mr. Symonds are valuable in view of his large experience of these cases:

"I would put the general question of treatment in the following way as applying to all cases. (1) While the patient can swallow fluids and semi-solids, and while a bougie can be passed and plenty of nourishment taken, he may be left alone so long as (*a*) he can swallow well or (*b*) a small bougie, No. 12 catheter gauge, can be passed. (2) If the dysphagia increases, even though a bougie can be passed, then a tube must be inserted, or gastrostomy must be performed. These conditions are seen in the soft fungating forms. (3) If a bougie cannot be passed or goes with difficulty, then the same course must be followed, as we know that complete closure may occur at any time. (4) If both conditions arise—*i.e.* the patient cannot swallow, and a bougie cannot be passed—then immediate mechanical treatment is required."[2]

Between the treatment by gastrostomy and that by tubes, no fair comparison can be made, because the former operation has, in such a large number of cases, been performed under most unfavourable conditions. Much too often it has been put off till the patient, scarcely able to swallow liquids, is just kept alive by enemata. Such patients, worn out by the miseries of slow starvation, often with secondary disease and lung and pleural trouble, are not in a condition to be submitted to abdominal section, and are not likely to respond to the call made upon their vitality to unite two serous surfaces firmly together, on which depends the success of the operation. I do not think that I

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[1] *Journ. Amer. Surg. Asso.* 1908, vol. li, p. 549. [2] *Lancet,* 1902, vol. ii, p. 351.

exaggerate if I say that, in a distinct proportion of the cases in which the surgeon is asked to perform gastrostomy, the hand of death is already on the patient and something next door to the decomposition of the grave has already set in, owing to the extension of the disease.

In advising gastrostomy, each case may be decided on its merits; the patients here are not only adults, but well on in life, and, when assured that the end is certain, the surgeon may in most cases, having put all the risks before the patient, leave it to him to decide. But I think that if the patient, having previously declined it, only asks for operation when it is clearly too late, the surgeon should be firm enough to decline to operate where, on every ground, his interference will be hopeless.

The following points help in a decision between gastrostomy, bougies, and tubage: (i) *Food taken.* As long as pulpy, semi-solid, or a proportion of solid food is taken, the occasional and very careful passage of a small bougie should be persevered with. Bougies should not be passed for the object of dilating the stricture. " It is injurious in that it irritates and leads to increase of obstruction; it may split a hard stricture, and set up rigor and fever from absorption."[1] A small bougie may be passed " simply to secure the route, so that at any time a tube can be passed for feeding purposes or the time fixed for gastrostomy." But when the patient is becoming restricted to liquids, and is wasting rapidly, a tube should be introduced or, failing this, a gastrostomy performed. When the patient is fed by enemata only, and merely takes ice by the mouth, it is too late to operate. (ii) *Amount of pain felt with and difficulty in passing bougies or tubes.* Any sensation of a rough, raw surface, any blood or broken-down tissue on the bougie, increased expectoration, dyspnœa, paroxysmal cough (this may occur after even a teaspoonful of fluids), fœtor of sputum or bougie, make it evident that the passage of instruments causes advance of ulceration and sloughing; when this is increasingly accompanied with pain and evidence of laryngeal irritation, gastrostomy should be proposed. (iii) *Site of stricture.* As shown by the X-rays the lower down this is the more difficulty will there usually be in dealing with it by dilatation, and the nearer are important parts. (iv) *Condition of patient.* Here the rate of emaciation must be watched; anything like loss of one to two pounds a week is very ominous. How far is the strength preserved? Where the pulse is thready, the extremities cold, the temperature never up to normal, the case has gone too far. (v) *Condition of viscera.* Evidence of implication of trachea or bronchi, of pleuritic effusion, and of broncho-pneumonia must be sought for. Phthisis sometimes develops or is reawakened in these patients, and is very apt to be overlooked on account of the masking of the symptoms by the disease of the œsophagus. If there is reason to believe that the growth has extended beyond the œsophagus, operation should usually be declined. (vi) *Rank of life.* A patient who can afford all the luxuries of life, and who can have everything done to palliate his condition, is obviously in a very different condition from one in a humbler position.

I would thus sum up this question of gastrostomy or tubage: As long as a patient can swallow sufficient food by this means, treatment by tubes is far preferable. Whenever they can be introduced, the

[1] Symonds, *Lancet*, vol. ii, 1902, p. 353.

tubes ingeniously devised by Mr. Symonds[1] are to be preferred. These have a funnel-shaped extremity resting on the upper end of the stricture, are introduced on a whalebone guide, and are kept *in situ* by a loop of silk which is passed round the ear. They have the great advantage of allowing the patient to swallow his saliva and food, and thus retain the pleasures of taste. These tubes may be retained in position for months; in one case under the care of Mr. Symonds the tube was worn unchanged for thirteen months. If the silk break, great trouble may accompany the removal of the tube, but this rarely occurs when the silk is protected by rubber tubing.

In one patient, who bit through the silk, the latter blocked the narrow part of the lumen of the tube. Prolonged attempts to withdraw the tube were of no avail, until, at the patient's suggestion, another Symonds tube was introduced into the original one. The introducer was withdrawn and traction made on the string of the second tube; this was at once successful, the tubes keeping together by suction.

Except for certain short strictures situated from ten to fourteen inches from the teeth, Mr. Symonds now uses his long rubber tube, which may last for about nine months. It should never be removed for cleansing purposes, on account of the difficulty of replacing it, unless this is attempted at once. Saliva cannot be swallowed, as a rule, when this tube is in. The tube should not be passed when the patient is under an anæsthetic, for it may enter the larynx and trachea when the former is insensitive, and this has been attended with disastrous consequences.

Any surgeon treating cancerous stricture here by tubage must remember that treatment of cancer in this way is contrary to what is generally practised, and is only justifiable here on special grounds— *e.g.* the fatality of the disease and the risks of gastrostomy; that these risks have been enormously increased by the way in which this operation has been deferred; that in these cases a time may come when tubes can no longer be made use of; and that if gastrostomy has been deferred till now, it can only be performed with greatly increased risk. In other words, the patient should understand that if he shuns the risks of an early operation, he renders himself liable to other, but as serious, risks by deferring it till an hour when he can only ask for it, and the surgeon only attempt it, as an almost utterly forlorn hope.

The question of which gives the greatest comfort cannot be answered dogmatically. But no one who has seen many cases of gastrostomy, and met with a fair proportion of success, will hesitate to prefer the result of this, if performed early, with its gain of weight and freedom from pain and irritation during the few months which in any case remain, to the passage of tubes necessarily more and more frequent and difficult as the case progresses, with the not infrequent distress and choking when they are introduced, the blockage of the hollow ones by sputum or food, and the needful withdrawal and reintroduction, easily effected, no doubt, for some time, but ever irritating and fretting the growth.

[1] *Clin. Soc. Trans.*, vols. xviii, p. 155, xxii, p. 306; *Brit. Med. Journ.*, April 23, 1887. See also Dr. Rodman's two cases, *Brit. Med. Journ.*, May 25, 1889. It is clear from these cases that the patients can be kept alive as long and gain weight equally by tubage as by gastrostomy, and that in some cases even a malignant stricture can be dilated. On the other hand, the passage of tubes, where there is considerable narrowing, clearly requires some force, and thus needs skilled and very careful hands. Even in such hands, fatal mischief has been inflicted. Furthermore, the blocking of the smaller tubes, which alone will pass in the later stages through tight and ulcerating strictures, may necessitate frequent changing, irritation, and thus hasten sloughing of the growth. The close contiguity of this to the trachea, pleuræ, &c., must not be forgotten.

Mr. Symonds[1] summarises his views upon the subject as follows :

" (1) In cricoid obstruction the long rubber tube gives excellent results. When not well borne gastrostomy, if selected, should be performed early. (2) In disease of the central portion the short tube is serviceable in a fair number of cases, and when it acts well is superior to any other method. It must be replaced by the long feeding tube when pulmonary symptoms arise. (3) In disease of the cardiac orifice tubage is so uncertain that gastrostomy should be performed when dysphagia becomes serious."

Mortality of gastrostomy. Robson and Moynihan[2] state that three deaths occurred in nine gastrostomies performed before 1896, and only three deaths in thirty-four of these operations since 1896.

T. P. Legg[3] in fifteen gastrostomies for cancer of the œsophagus, had three deaths within a fortnight of the operation ; nine survived for periods varying from six weeks to seven months, and two of these were still living when Mr. Legg wrote his paper ; they had survived for six weeks and five months respectively.

The best time for performing gastrostomy is when the patient is beginning to lose weight and strength rapidly in spite of all care in feeding and in spite of the aid of œsophageal tubes in suitable cases. It should be done early enough to allow healing to take place.

OPERATION. (1) **Abbe's modification of Kader's method,** *also called Senn's operation.*[4] All possible precautions are taken against shock ; morphia one-sixth or one-fourth grain and scopolamine one-hundredth grain are injected subcutaneously so that very little general anæsthetic is required. A little ether or C.E. given by the open method suffices. Novocaine anæsthesia is used when a general anæsthetic is contra-indicated. The shoulders should be somewhat raised and the hips slightly flexed so as to relax the abdominal wall, which often falls with embarrassing sharpness over the epigastric angle from the prominent ribs down to the wasted, retracted umbilical region.

Fig. 59. Abbe's modification of Kader's method of gastrostomy ; purse-string and parietal sutures placed.

A vertical incision is made over the upper and outer third of the left rectus extending from the level of the tip ensiform cartilage downwards for two and a half inches. The sheath of the rectus is opened, the vertical fibres of this

[1] *Loc. supra cit.*
[2] *Diseases of the Stomach,* 1904.
[3] *Lancet,* vol i, 1905, p. 174.
[4] *Ann. of Surg.,* January 1899, p. 113.

muscle are separated and the posterior wall of its sheath is exposed. This and the peritoneum attached to it are incised together for about an inch and a half. Two fingers are then introduced to feel for the stomach. As a rule the latter is contracted and lies high up under the left lobe of the liver, and requires to be hooked downwards and forwards into the wound. Not infrequently the great omentum presents itself first, and it is easy, by seeking too low down, to draw up the colon. By drawing the great omentum and the colon downwards the stomach comes into view and is brought into the wound. An opening is made well away from the pylorus and about half way between the lesser and greater curvatures. At this spot a small opening just large enough to admit a No. 12 rubber catheter is made with a knife. The catheter or tube of a similar size is introduced and passed into the stomach for two inches, and is then secured by a catgut suture piercing it and all the coats of the stomach. A purse-string sero-muscular suture of catgut is then inserted half an inch away from
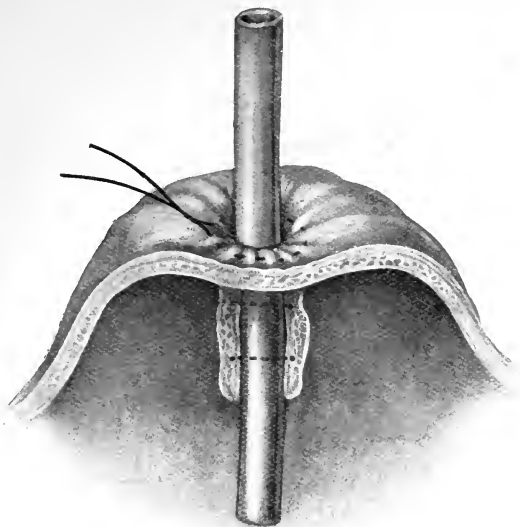
FIG. 60. Abbe's modification of Kader's method of gastrostomy. Section showing the effect of tying the purse-string sutures round the rubber-tube.

the tube, which is pushed in by an assistant as the suture is tied just firm enough to grip without compressing the tube. Two or more similar sutures are introduced and tied, with the result that an inverted cone projects into the stomach around the tube. A valve closely resembling that of an ink bottle is thus produced, and seldom leaks even months after the operation. The stomach is fixed to the parietal peritoneum by means of two catgut sutures, which are passed one above and one below the tube through the posterior wall of the rectus sheath and parietal peritoneum, and picks up a wide strip of the sero-muscular coats of the stomach. The incision is then closed in layers in the usual way.

Half a pint of milk or milk and egg is introduced at once into the stomach through the tube by the aid of a funnel fitted into the upper end of the tube. After a week or ten days the tube becomes loosened and is then passed at meal times. It should be left in position, however, for a portion of each day, otherwise contraction occurs, and there may be difficulty in its reintroduction. On the other hand, if it is left constantly in the opening enlarges from the elastic pressure of the tube.

A dressing is applied until the wound is healed. The fishing-gut

sutures are removed at the end of ten days. The patient is at first fed at frequent intervals. Milk thickened in various ways is the best food, but beef tea and soup may also be given if there is no diarrhœa. The patient is also allowed to swallow water, milk, and other foods by the mouth if he is able. In any case his mouth is frequently washed out with water, a solution of hydrogen peroxide or lemon and glycerine, to keep the mouth clean and to slake thirst. The teeth are also carefully cleaned.

I prefer this operation to all others, and it is especially valuable as it can be quickly performed on a very contracted stomach and without fear of leakage.

(2) **Witzel's**[1] **method.** The stomach having been drawn out, a very small opening is made as in the previous operation, a snugly-fitting
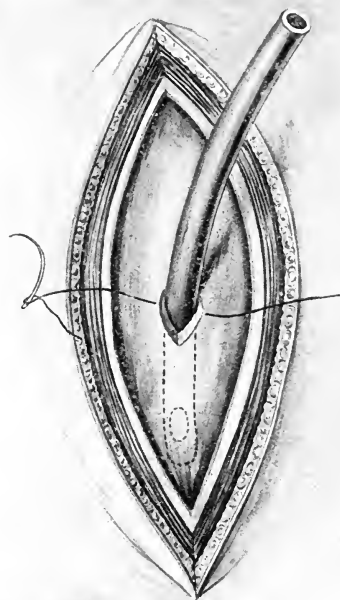
FIG. 61. Witzel's method of gastrostomy. Stitch to hold the tube to the edges of gastric opening.
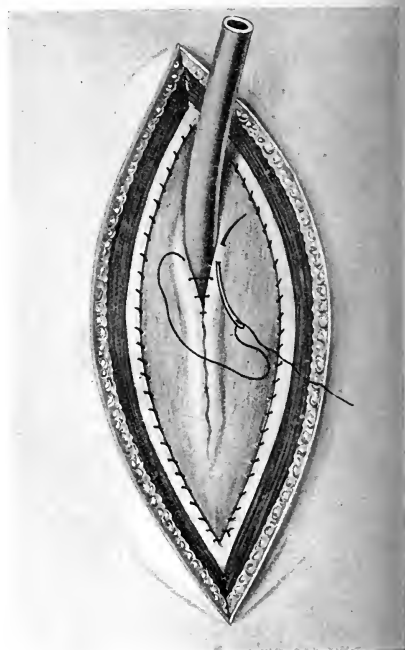
FIG. 62. Witzel's method of gastrostomy. The Cushing suture is shown burying the tube and gastric opening. The stomach has been sewn to the parietal peritoneum.

rubber tube or No. 12 catheter introduced and fixed by means of a single catgut suture piercing it and all the coats of the stomach, and then buried in the wall of the stomach for about two inches by Lembert's sutures, two folds of the stomach wall being stitched over the tube, as seen in Fig. 62. A continuous Lembert stitch is simpler, quicker, and just as good as interrupted sutures. The free end of the tube is then brought out of the wound, while the area around it is stitched to the peritoneum on either side of the wound in the parietes. The edges of the wound having been sutured, the upper end of the tube may be

[1] *Centr. f. Chir.*, 1891, p. 601.

closed with a clip, and a sealed dressing applied. Feeding by the stomach is begun at once. Any leakage is prevented, not only by this oblique entrance of the tube into the stomach, but, as shown by a specimen obtained from a patient of Dr. Meyer,[1] by the fact that Witzel's ingenious method of stitching the stomach walls over the tube causes a short artificial cone to protrude obliquely into the lumen of the stomach.[1] Mikulicz and Helferich have shown that, after a lapse of a few months, the oblique passage may become a direct one. Marwedel incises the sero-muscular coats and buries the tube between these coats and the mucous membrane. This takes a little more time, causes some bleeding and is no more efficient than the simpler operation of Witzel.
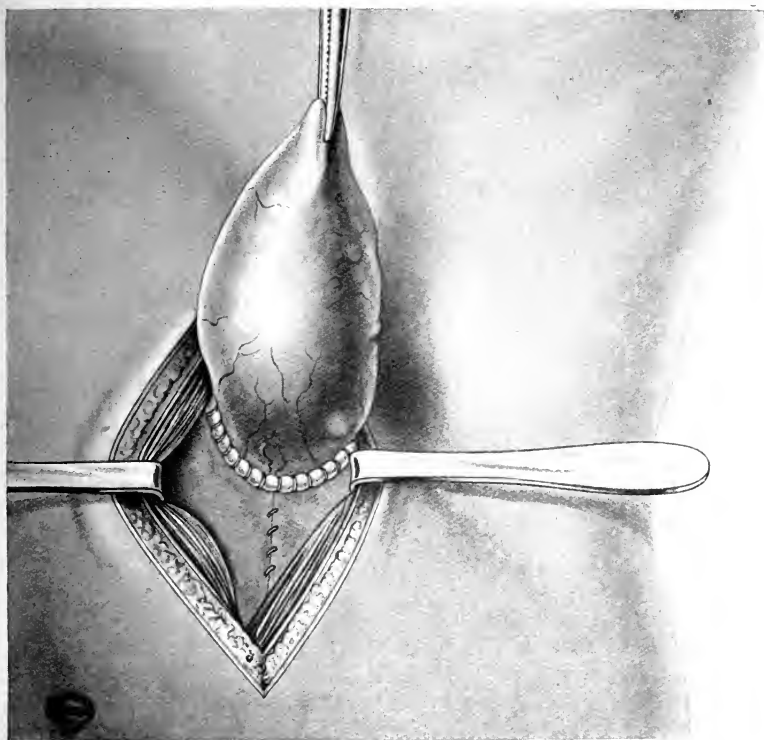
FIG. 63.   Gastrostomy by Frank's method.   (After Kocher.)

(3) **Frank's** [2] **method.** The peritoneum is opened either by an incision parallel with the costal cartilages, or by one just within the linea semilunaris high up. The stomach having been drawn out, a long conical diverticulum of the anterior wall of the viscus is pulled well out of the wound, and the parietal peritoneum and the posterior layer of the sheath of the rectus are sutured round its base, care being taken not to constrict it too much (Fig. 63). A continuous suture is used, without

[1] Another advantage of Witzel's method is illustrated by one of his cases. In a patient who had been operated upon for cicatricial stricture of the œsophagus, the fistula closed spontaneously within sixteen days after the stricture had been dilated and the tube removed from the stomach (Meyer).

[2] Albert, Ssabanijews-Frank.

perforating the mucous coat of the stomach. A small transverse incision is now made through the skin a little above the costal margin. The skin between the two openings having been separated from the subjacent parts, the diverticulum of the stomach is drawn up under the skin and over the costal cartilages as far as the small skin incision, to the edges of which its apex is united by a few sutures. A small opening is next made here into the stomach, and the orifice fixed to the skin by one or two points of suture (Fig. 64). The lower part of the wound is then closed by a continuous suture. As a result the diverticulum of the stomach is drawn upwards, its base is gripped by the muscular fibres of the rectus, while a short upward-directed subcutaneous œso-

FIG. 64. Gastrostomy by Frank's method completed (After Kocher.)

phagus is also formed. All escape of fluid is thus prevented, and the patient can be safely fed at once. This operation is not so easy as those already described and may be very difficult when the patient is very thin and the stomach drawn up and small. Moreover the channel tends to become direct so that leakage occurs in some cases after some months.

Mr. T. P. Legg[1] draws out a cone of stomach two and a half inches long if possible, and pulls this for one and a half inches to the left through the rectus muscle, the fibres of which have been separated into anterior and posterior bundles. The base of the cone is fixed on its right border by about five stitches to the posterior wall of the rectus

[1] *Lancet*, 1905, vol. i, p. 1711.

sheath and peritoneum, and near its extremity it is secured by four sero-muscular sutures to the rectus sheath, and to the skin wound, which is an inch long and is parallel to the rectus muscle fibres and the original wound. The latter is closed by means of salmongut sutures, which include the anterior layer of the rectus sheath, and some of the fibres of the muscle. A sealed dressing is applied to the wound. It is claimed that this operation provides a better sphincter for the fistula, owing to the greater length of cone which is surrounded by muscle fibres. In only one of the fifteen patients operated upon by Mr. Legg was there any leakage, and this only lasted a month and was probably due to the sloughing out of some of the stitches which occurred.

(4) **Tavel's jejuno-gastrostomy.**[1] Tavel makes a new œsophagus several inches long from a loop of jejunum. The distal end is joined to the stomach and the other end is brought out through the abdominal wall high up. A large channel is thus obtained without leakage. The skin incision is made through the left rectus and lower than is usual for ordinary gastrostomy, its centre being on a level with the navel. A loop of jejunum with a long mesentery is selected, and divided at two points between two pairs of clamps. The continuity of the bowel is then restored by making an end to end union between the cut ends above and below the loop. The loop of jejunum attached to its carefully preserved mesentery is brought forwards through the transverse meso-colon aud gastro-colic ligament; its anal end is inserted into the anterior wall of the stomach while its oral extremity is brought out through a special opening as high up as possible in the abdominal wall and sewn to the skin. I have found it easier to bring the separated jejunal loop up in front of the omentum and colon.

Tavel says that the fistula does not leak, but is kept continent by the normal peristalsis of the bowel. (Figs. 65 and 66.)

It is clear that the operation is a very much more serious and prolonged one than ordinary gastrostomy, and that most patients requiring gastrostomy are not in a condition to bear it. However it has the advantage that more solid food can be given, so that it may be tried when the patient's condition warrants it, and especially when the œsophageal stricture is non-malignant and yet permanent.

Roux of Lausanne[2] in a boy aged 8, with impermeable stricture of the œsophagus, has used a long piece of jejunum, bringing its upper end under the skin to the root of the neck, hoping later to join it to the œsophagus. The new tube acted well. Fig. 65 shows how the vessels of the jejunum allow division of a good deal of the mesentery without seriously interfering with the blood-supply.

Difficulties in and after gastrostomy. (1) The very prominent angle formed between the ribs and the sunken umbilical region. (2) Hæmorrhage. This will be almost nil if the rectus fibres are separated with a director, and the veins on the stomach carefully avoided. (3) Finding the stomach. (4) Drawing this up into the wound if itself affected by disease, as when the primary disease is situated very low down in the œsophagus, or if it is adherent by reason of secondary deposits. (5) Jerking breathing due to the anæsthetic. (6) Completing the second stage of the operation. (7) Intense pain on introducing food into the stomach.

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[1] *Kocher Op. Surgery,* 1911, p. 608.
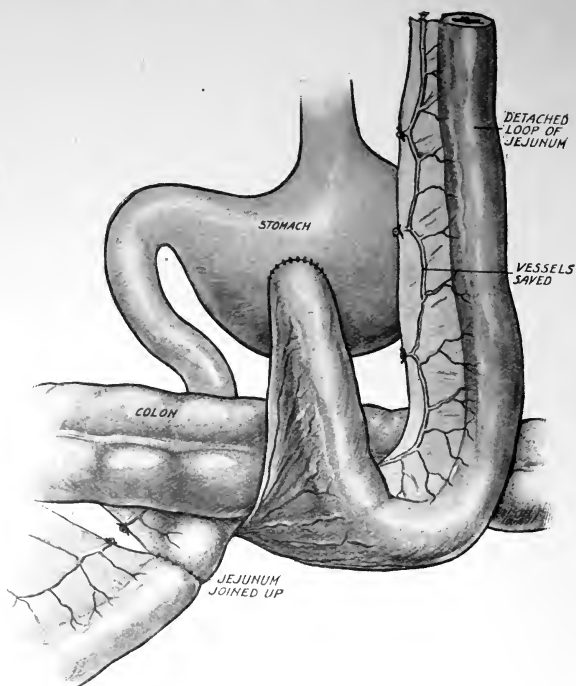[2] *Semaine Medical,* January 1907.

Fig. 65. Tavel's jejuno-gastrostomy. A loop of jejunum has been detached to serve as a new œsophagus, the jejunum being restored by end-to-end union.
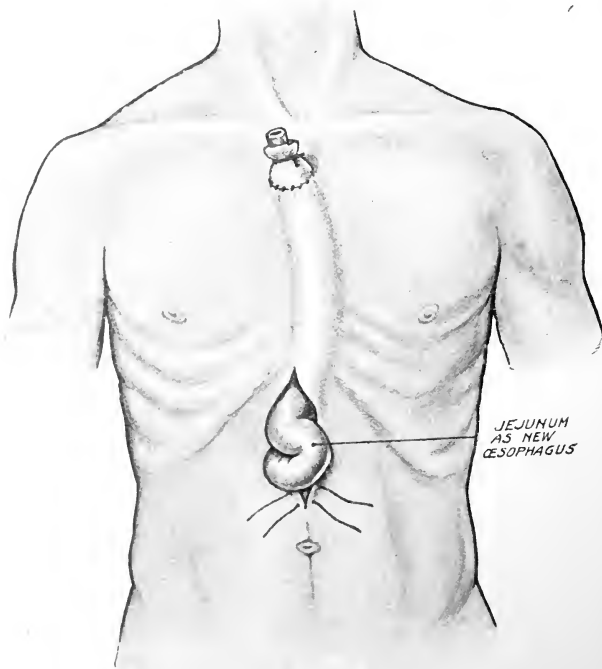

Fig. 66. Tavel's jejuno-gastrostomy.
The jejunal loop has been drawn up between the skin and the sternum.

In a patient of Mr. Butlin's [1] this was found to be the case, the patient dying nearly a month after the operation. Mr. Butlin attributes this pain to his opening having been close to the pylorus.

If it is thought that the opening is made too near either extremity of the stomach, it would be well, after feeding, to keep the patient turned on the opposite side. (8) Leakage of gastric juice and regurgitation of food. This is an extremely troublesome complication, leading, as it does, to most rebellious dermatitis; it is fortunately quite rare with modern methods.

Causes of death after gastrostomy. (1) Inanition and exhaustion, the operation being performed too late. (2) Peritonitis. (3) Extension of the disease to surrounding parts, *e.g.* trachea, bronchi, &c. (4) Lung affections, *e.g.* pneumonia, due in part to the operation, viz. the anæsthetic and enforced recumbency—and in part to the saliva, which cannot pass down the œsophagus, being drawn into the air-passages, either before or during the operation. (5) Hæmorrhage, *e.g.* from ulceration into aorta or lung. (6) Acute gastritis. (7) Suppuration between stomach and liver. (8) Phthisis.

[1] *Brit. Med. Journ.*, April 14, 1883.

THE SURGICAL TREATMENT OF CHRONIC GASTRIC AND DUODENAL ULCERS

THE progress of gastric surgery during the last fifteen years has been amazing, for both the immediate and ultimate results of operations for ulceration of the stomach and duodenum have been very gratifying, and are still steadily improving. In the hands of experts the mortality of gastro-enterostomy for these conditions has been reduced well under 1 per cent., and the ultimate results are good in about 95 per cent. At first operations were undertaken only for the relief of complications such as perforation, recurrent hæmorrhage, pyloric stenosis or hour-glass contraction. Too often the surgeon was only asked to operate when the patient had tried all other means and had become exhausted by years of pain, misery and malnutrition. Now it is widely recognised that early operation offers the best and often the only hope for patients suffering from these complications. But the great advantages of operating before any complications have had time to develop is not yet properly appreciated except by a few surgeons who are familiar with the pathology of the living ascertained during operations performed at all stages of gastric ulceration. No responsible surgeon would suggest operating for *acute ulceration apart from perforation or severe recurring hæmorrhage*, and fortunately both these very rarely complicate *acute* ulceration. Usually the acute ulcer heals under proper medical treatment, which should be patiently and very thoroughly carried out, in order to prevent the ulcer becoming large, chronic, callous and intractable.

Chronic ulceration is very intractable and causes far too many deaths. Out of 556 cases admitted into St. Thomas's Hospital [1] 13·3 per cent. died, 8·5 per cent. from perforation and 1 per cent. from bleeding. At the London Hospital [2] out of 500 cases 18 per cent. died, 10 per cent. from perforation. Apart from death, chronic ulceration often causes untold misery, saps the vitality and seriously reduces the earning capacity of a great many patients, many of whom become chronic invalids. Dr. Hawkins estimates that not more than 66 per cent. of those discharged apparently well after a course of medical treatment remain well, and that about 10 per cent. are readmitted for recurrence of symptoms, and about 15 per cent. for perforation and other sequelæ. This is a modest estimate. Others have reckoned that less than 50 per cent. are cured. It is most important to realise that the dangers and disabilities of gastric and duodenal ulcers increase enormously with time. Some improvement in the results may be obtained by earlier, more thorough and prolonged medical treatment, but this is very difficult to adopt for poor patients,

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[1] Dr. Hawkins, *Royal Med. Chir. Trans.*, vol. xc, 1906, p. 269.
[2] Dr. Bulstrode, *Chir. Soc. Trans.*, 1903, p. 986.

especially for men who have families depending upon them. Whenever possible three months' rest in bed on a diet consisting of milk, egg, sugar and olive oil should be tried. When the symptoms either do not abate or recur after this an operation should be advised. In private practice under favourable circumstances medical treatment may be given a longer trial if the patient is not wasting. In some cases, especially when proper medical treatment is impracticable or the patient does not improve under it, an operation should be undertaken earlier. Surely it is better and far easier to operate before the ulcer becomes large, callous, adherent and thick-walled, before dangerous complications develop, and before malignant disease supervenes.[1] The risk of an operation is small, say 2 per cent. compared with the danger of waiting, say 12 per cent. and the prospect of cure of a chronic ulcer from early operation is infinitely greater than from the most careful medical treatment. The earlier the operation the easier and less risky is it likely to be.

When the patient loses flesh in spite of careful medical treatment an exploration is to be undertaken without delay, for *malignant disease is probable* and can only be treated radically by early operation. Another important reason for exploring the abdomen when medical treatment for a reasonable time has been tried in vain, is that in a good proportion of cases the diagnosis is found upon exploration to be incorrect. Chronic appendicitis or gall-stones are found. For these the orthodox medical treatment of gastric ulcer is useless, whereas a radical operation offers a splendid and immediate prospect of cure.

In other cases early malignant disease of the stomach or bowel may be discovered while yet amenable to radical treatment. While much may be learnt from the history and observation of the patient it must be admitted that it is very difficult to be sure of the diagnosis of gastric ulcer apart from such complications as pyloric obstruction. When the ulcer is well away from the pylorus the X-rays may reveal nothing abnormal beyond an over-active small stomach; this is common with an ulcer upon the lesser curvature of the stomach or in the duodenum. Pyrosis and hyperchlorhydria are often noticeable, but their absence does not exclude chronic gastric ulcer. Pain in the epigastrium or left hypochondrium and below the left scapula coming on soon or within an hour after meals are suggestive. Definite and constant deep tenderness and cutaneous hyperæsthesia in those regions are more reliable. Increase of pain and tenderness often precedes perforation. Bleeding only takes place in about 40 per cent. Anæmia and some wasting are usually evident. Duodenal ulcer appears to be nearly twice as common as gastric ulcer; it is far more common in men and is indicated by pain coming on 2–3 hours after food and relieved by food—"hunger pain." The right rectus is often rigid on palpation. The gastroscope may reveal gastric ulcer, but cannot yet be trusted to exclude or disprove malignancy. In spite of all care the diagnosis often remains uncertain until the abdomen is opened, when an accurate diagnosis can be made within a few minutes and appropriate treatment can be immediately adopted. Before suggesting an exploration every care should be taken to exclude the possibility of nervous, renal, pulmonary or other disease by the usual careful systematic examinations.

[1] Wilson and MacCarty, from histological examinations of the specimens from 218 partial gastrectomies at the Mayo Clinic, conclude that " 71 per cent. of the cancers had their origin in chronic gastric ulcer." *Collected Papers*, Mayo Clinic, 1910, p. 107.

Operation. A free incision is made through the upper and inner third of the right rectus, and a hand is passed down to explore the pelvis. Then the cæcum and appendix are examined and nearly always the latter is found to be in a state of chronic inflammation and should be removed; otherwise the symptoms may not be completely relieved. Moreover, it is certain that a diseased appendix has a deleterious influence upon the physiology and pathology of the stomach and duodenum. The gall-bladder is also examined, and if the condition of the patient allows, any stones which may be found should be removed towards the end of the operation. The stomach and duodenum are very carefully palpated and inspected, and if no obvious disease is found no gastric operation should on any account be performed. An ulcer too small to be discovered without opening the stomach will probably heal under medical treatment. If an ulcer is found at or near the pylorus either in the stomach or duodenum, gastro-jejunostomy should be performed and is nearly always successful. In some cases a small ulcer in this neighbourhood may be excised, but it is often enough to infold it with a serous suture to prevent perforation or hæmorrhage. When malignancy is suspected or a large tubular yet removable ulcer exists, the ulcer-bearing area should be removed. This generally means a partial gastrectomy and adds considerably to the immediate danger of the operation, but the chance of malignant disease justifies the added risk. When the ulcer is in the stomach and well away from the pylorus, the best treatment is still uncertain. (i) *Gastro-jejunostomy,* (ii) *excision or infolding, or* (iii) *a combination of these may be adopted.* (i) *Gastro-jejunostomy* although it has not proved quite so successful for these cases as for pyloric stenosis, has in my experience usually brought immediate relief of symptoms. The severe pain commonly associated with an ulcer high upon the lesser curvature instantly ceases so that the patient can eat well and regain his weight. This success is explained by the neutralisation of the over-acid gastric juice by the admixture of bile and pancreatic juice, and the cessation of the painful spasm of the stomach and pylorus. The new aperture if large enough provides an additional and readier exit for the food so that the ulcer is no longer irritated or stretched. X-ray examination before and after operation proves these statements to be true. And all these benefits are conferred at the small risk of gastro-jejunostomy. In some cases this is the only reasonable operation, for the ulcer or ulcers may be so large, inaccessible or adherent as to be irremovable without grave risk.

The disadvantages of this treatment are :

(*a*) That a callous chronic ulcer may not heal in spite of the relief of symptoms, or healing may be long delayed in spite of appropriate after-treatment. In one of my cases, although the man improved out of recognition, a sudden profuse hæmorrhage from the coronary artery occurred six months later. I successfully removed the ulcer from the cardiac end of the lesser curvature after the third bleeding and the patient made a good recovery.

(*b*) The ulcer may be or later become malignant. In one of my cases apparently fairly successful for a year, signs of malignant disease with paraplegia developed, and the patient died within eighteen months of the operation. The systematic histological examination of excised ulcers often reveals unexpected carcinoma.

(ii) *Excision.* When practicable this should be done, for there is little doubt but that a clean-cut wound is more likely to heal and remain

healthy than a callous chronic ulcer.   Moreover malignant growth may be thus removed or prevented.[1] Upon histological examination, what appears to be a simple ulcer often proves to be carcinomatous.

Some surgeons believe that excision is enough, but others urge that gastro-jejunostomy should be added with the object of preventing future ulceration by neutralising the acid gastric juice. Dobson records ten
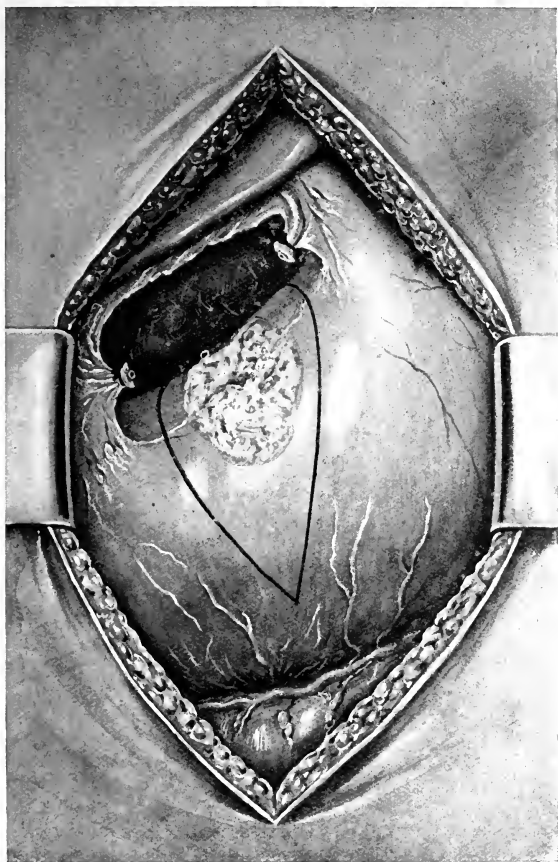

FIG. 67.   Excision of gastric ulcer; the vessels in the lesser omentum have been tied and the lesser omentum divided, showing the upper part of the posterior wall of the stomach.

cases of resection without gastro-enterostomy. Ulceration recurred in four within twelve months. One of these died later of perforation. Secondary gastro-enterostomy was satisfactory in two, and in another, secondary excision with gastro-jejunostomy was successful.[2] Excision of a gastric ulcer may be a very formidable operation, and the patient may not be able to bear it and gastro-jejunostomy at the same time. In such cases infolding may be done instead, and when this is added to gastro-jejunostomy a simple ulcer may be expected to heal. It is well known

[1] MacCarty, *loc. cit.*, p. 99, found 68 per cent. of resected ulcers of the stomach, including duodenal ulcer, which rarely becomes malignant, were associated with carcinoma.
[2] *Brit. Med. Journ.*, 1912, ii, p. 864.

that infolding even without gastro-jejunostomy nearly always successfully aids the healing of a perforated ulcer, but the danger of existing or future malignancy remains.

(iii) Excision, together with gastro-jejunostomy, seems to be the ideal treatment when the general condition of the patient is fair and the local conditions are favourable.

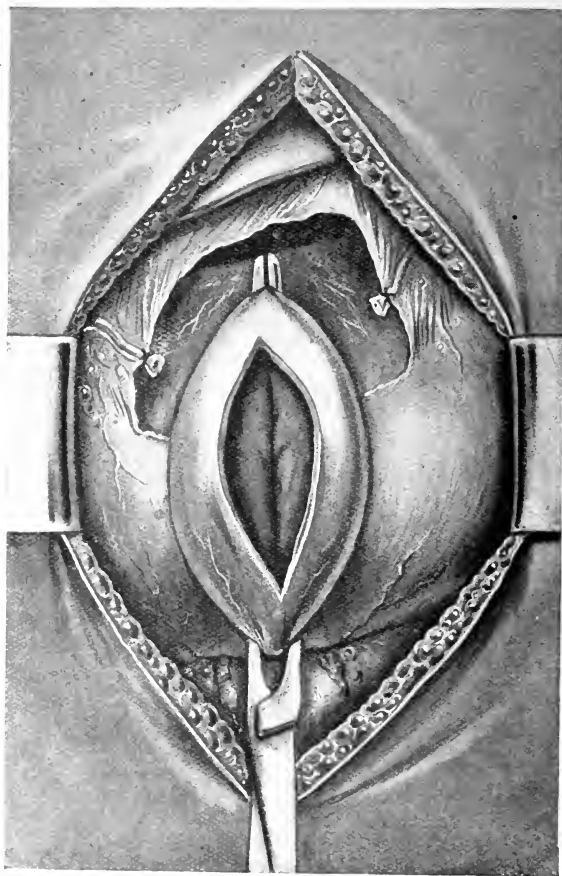**Duodenal ulcer.**   For *duodenal ulcer* I believe it wise to operate after

Fig. 68.   Excision of gastric ulcer.   Here a single clamp sufficed.   The ulcer has been excised and the wound is ready for suture.

two definite attacks.   As regards excising a duodenal ulcer, there appears to be little need of this for a duodenal ulcer almost invariably heals as a result of gastro-jejunostomy, and the chance of malignant changes in the duodenum is very remote.   It is usually sufficient to infold the ulcer. Some surgeons narrow the pylorus by infolding.   Excision of the ulcer-bearing area, *i.e.* of the first portion of the duodenum has been suggested, but this seems much too formidable considering that the results of gastro-jejunostomy for this condition are usually so very good.

EXCISION OF A GASTRIC ULCER

This operation may be very difficult especially when the ulcer is high and adherent on the lesser curvature or posterior wall of the stomach. A large ulcer invading the liver or pancreas is usually irremovable without undue risk to the patient's life, and for these it is better not to attempt
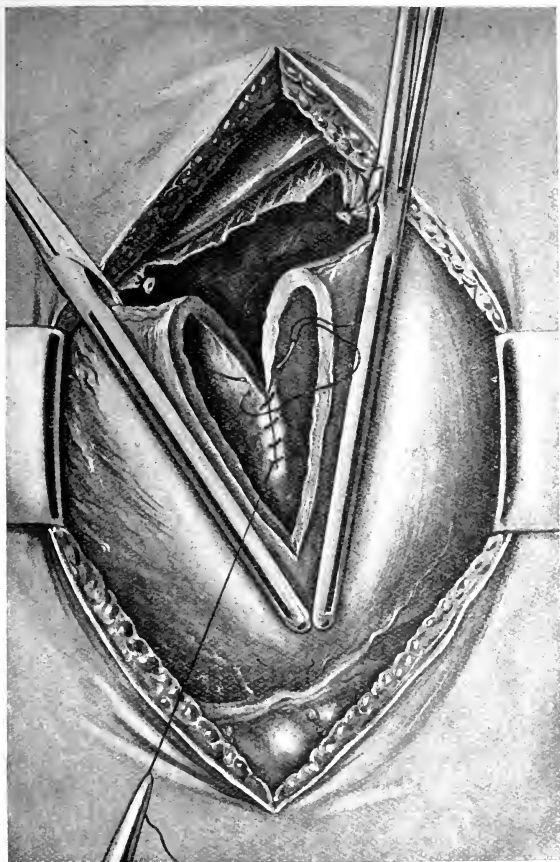
FIG. 69.   Excision of gastric ulcer.   Two clamps used.   Suture of the wound starting below and behind.

anything beyond gastro-jejunostomy and prolonged medical after-treatment.

As usual the abdomen is thoroughly but quickly explored, the appendix removed if time permits, and the stomach and duodenum carefully examined before any attempt is made to remove an ulcer. Adhesions are separated by gauze dissection and any bleeding vessels are tied. (1) *If the ulcer is limited to the anterior wall of the stomach* it is picked up with the fingers and thumb of the left hand while the right hand applies a strong clamp well behind it. An assistant holds the clamp and draws it downwards and to the right. Packs are carefully placed to protect the peritoneum and the edges of the wound, and an incision is made

around the ulcer and about half an inch away from it. When the clamp has been properly placed the lips of the gastric wound project about an inch beyond it, so that the wound may be easily closed without shifting the clamp. Two continuous sutures are used, one of strong catgut begins above, pierces all the coats and is drawn and held taut throughout to prevent bleeding. The other of fine linen thread is inserted after the clamp has been removed, and its insertion is facilitated
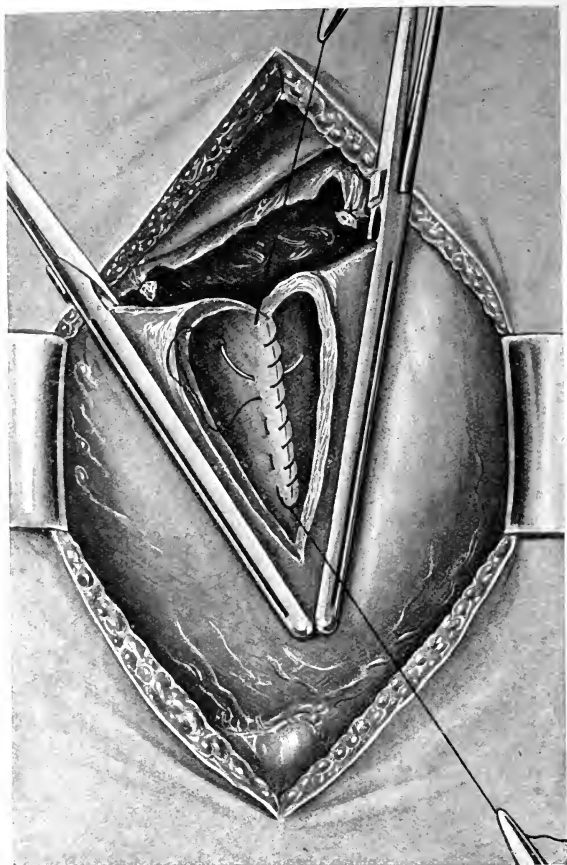

FIG. 70. Excision of gastric ulcer, the posterior continuous. A Connell suture is being inserted from within the stomach.

by traction upon the lower end of the deep suture, which is temporarily left long for this purpose (see Figs. 68 and 71).

(2) *When the ulcer is upon the lesser curvature*, the lesser omentum is divided at a bloodless part well above the ulcer and any enlarged glands that may be present. The gastric and pyloric vessels are then tied and divided above and below the ulcer. The fingers of the left hand are passed through the opening in the lesser omentum and the ulcer is thus grasped and brought down for the application of clamps. In some cases a single strong clamp suffices, the stomach being rotated so that the tips of the

blades can reach well beyond the posterior inferior extremity of the saddle-shaped ulcer. A pack of gauze is introduced behind the stomach, and the ulcer is excised as already described (*see* Figs. 67 and 68).

When the ulcer is large and not easily accessible two clamps are necessary and are applied from above down on either side of the ulcer. It is an advantage to have the left one bayonet-shaped to dodge the left
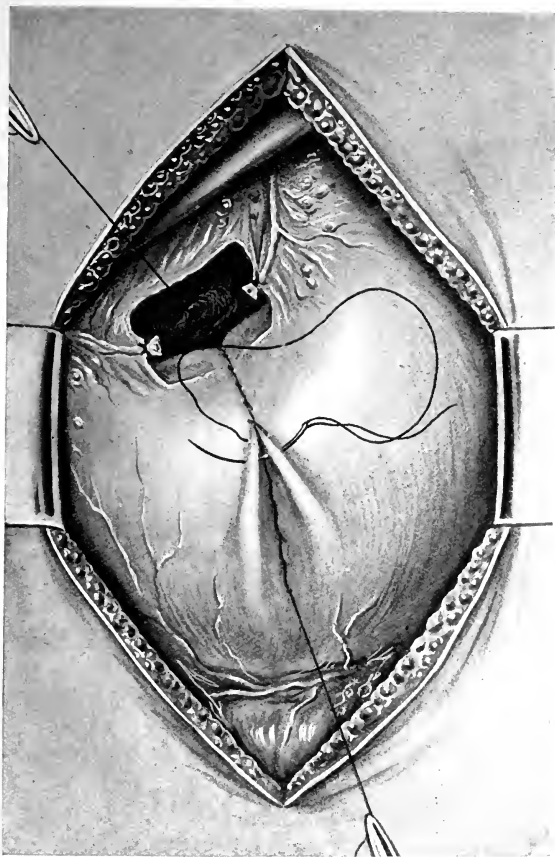

FIG. 71. Excision of gastric ulcer. The first and second sutures are nearly completed.

costal margin. The ulcer is excised without approaching too near the greater curvature. The clamps are approximated and the large wound thus left is closed with two layers of sutures. This may be very difficult as regards the posterior part of the wound. Whenever possible a continuous Connell suture of catgut is introduced and reinforced by a continuous Lembert or Cushing suture.

The sewing is commenced at the posterior inferior angle of the wound. When the wound extends far down upon the posterior surface of the stomach it may be almost impossible to insert the serous suture in the usual way. The posterior inferior angle of the wound is seized with tissue forceps and drawn downwards and forwards, while an ordinary continuous

piercing suture is rapidly inserted from below upwards as far as the lesser curvature. The needle is then passed under the last turn and laid aside while a Connell suture is introduced from below up from within the stomach. This " loop on the mucosa " suture buries itself so that none of it is seen on the serous surface and there is no risk of leakage along it. When the lesser curvature has been reached the needle, after passing from
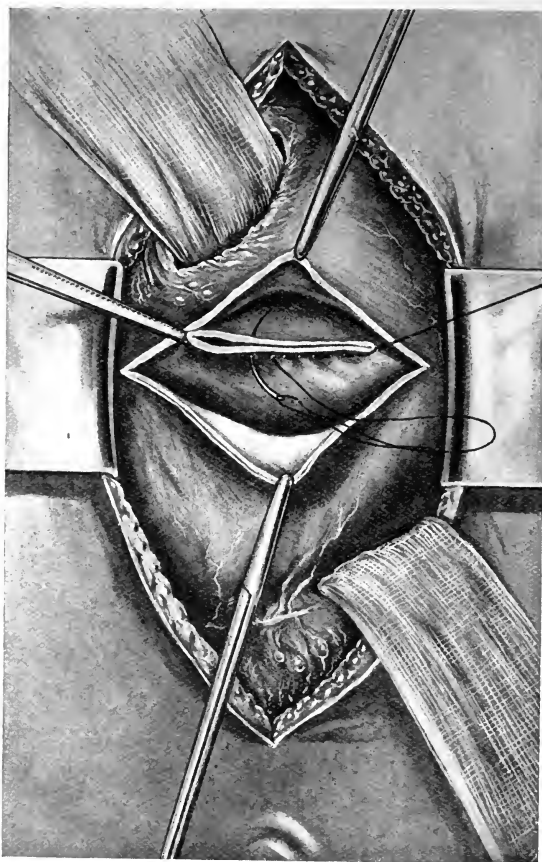

FIG. 72. Transgastric excision of a gastric ulcer (after Mayo). A Connell continuous suture is being inserted after the ulcer has been excised.

within out on to the serous surface on the left of the wound, is laid aside while the deep suture is completed after Connell's method. The second suture is then completed as a serous suture (see Figs. 69 to 71).

Sometimes an ulcer low on the posterior wall of the stomach is best approached from below through the gastrocolic omentum. Occasionally the opening left after a removal of the ulcer can be used for posterior gastro-jejunostomy.

(3) *Transgastric Excision.*—Sometimes adherent ulcers on the posterior wall of the stomach cannot be reached satisfactorily either through the lesser omentum or gastrocolic ligament or both. Then *transgastric*

excision [1] is indicated.   W. J. Mayo [2] gives a good account of this operation.

"**The gastro-hepatic** and gastro-colic omenta are opened above and below the ulcer.   Gauze protection is introduced, adhesions are carefully separated, and, if possible, the ulcer surface is cut free from the posterior attachments without opening the stomach.   A piece of gauze is packed into the denuded area behind, and in all but one of our cases this temporary pack was adequate to stop hæmorrhage without the ligation of vessels.   The anterior wall of the stomach is opened, and with the fingers behind, the entire ulcerated surface is pressed through the anterior incision and the ulcer excised,   The gap is sutured with through-and-through sutures of chromic catgut from the mucous side transversely, and this suture line is further protected by several mattress sutures of linen, applied from the mucous side to prevent separation due to the early absorption of the catgut.   The anterior wall of the stomach is then closed.   Several rubber-tissue drains are carried down behind the stomach and brought out at the upper end of the abdominal wound as a safeguard " (*see* Fig. 72).

[1] Pilcher, *Long Island Med. Journ.*, May 1907.
[2] *Ann. of Surg.*, Dec. 1910.

CHAPTER IX

OPERATIONS FOR HÆMORRHAGE FROM GASTRIC AND DUODENAL ULCERS

OBVIOUS hæmorrhage takes place in only about a quarter of the cases of ulceration of the stomach and duodenum, and even then it is usually a late symptom, although it is sometimes the first sign of an acute ulcer. It is needless to say that there are other causes of hæmatemesis and melæna such as congestion of the mucous membrane due to cirrhosis of the liver or heart disease, carcinoma of the stomach, and various diseases of the blood.

It is not very easy to estimate the percentage of deaths from hæmorrhage in cases of gastric ulcer under medical treatment for the fatalities vary inversely with the duration and thoroughness of the treatment. Dr. Bulstrode [1] collected the records of 500 cases of gastric ulcer admitted into the London Hospital between 1897 and 1903. He found that 2·5 per cent. of these patients died from hæmorrhage, 10 per cent. from perforative peritonitis, and altogether 18 per cent. of the patients died. In 42 per cent. of the cases, from one to four or more relapses occurred.

Dr. Hawkins and Mr. Nitch [2] found that less than 1 per cent. of 419 consecutive cases of gastric ulcer collected from the records of St. Thomas's Hospital died of bleeding, 10 per cent. were readmitted for recurrence of symptoms, and 15 per cent. for perforation of a chronic ulcer. The total mortality of the 556 cases at St. Thomas's Hospital was 13·3 per cent. ; 8·5 died from perforation and the remainder from sequelæ.

These figures show how efficient medical treatment for bleeding may be if carefully carried out, but unfortunately it is not practicable under existing circumstances to treat the poor subjects of gastric ulcer by rest and dieting for the long time that is necessary for cure. Too often they have to return to work when only beginning to recover, and it is not surprising that relapses are so frequent.

It should be remembered also that a timely operation for the relief of recurrent hæmorrhage may not only arrest the bleeding, but may lead to healing of the ulcer, and prevention of perforation and other complications and sequelæ, which, although they may not always be immediately fatal, yet shorten or spoil many lives.

That hæmorrhage is an important cause of death is shown by the following facts. Dr. Wall [3] found that of the cases of gastric ulcer with bleeding as a symptom 6 per cent. of the women and 12·5 per cent. of the men over thirty years of age died from hæmorrhage alone. MacNevin and Herrick (quoted by Hale White [4]) state that of 55 cases of undoubted gastric ulcer, shown at a post-mortem examination, which died from

[1] *Clin. Soc. Trans.*, 1903, p. 86.　　[2] *Royal Med.-Chir. Soc.*, vol. xc, p. 269.
[3] *Clin. Soc. Trans.*, 1903, p. 90.　　[4] *Loc. infra cit.*

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either perforation or hæmorrhage, 25 died from hæmorrhage. Of these 19 were males and 6 were females, of the 30 dying from peritonitis 8 were males and 22 were females, and of the 25 of both sexes dying from hæmorrhage all except one female were thirty years of age or over.

The ulcers which give rise to serious hæmorrhage are usually situated on the posterior wall of the stomach, and nearer to the lesser curvature than the greater. The character of the ulcers is very variable. They may be small and quite superficial, when the bleeding commonly arises from vessels in the submucous layer ; or they may be deep and adherent to structures outside the stomach, leading to ulceration of large vessels, such as the aorta, the hepatic, coronary, splenic, or gastro-duodenal arteries. It should also be borne in mind that in a number of cases more than one ulcer or erosion are present, and that in others the ulceration may be in the duodenum, or that no ulcer may be discovered, or even exist.

Dr. Hale White [1] has collected 29 cases of " gastrostaxis," or the oozing of blood from the mucous membrane of the stomach. Only two of these patients were males, and most of them were women well under forty years of age. Although this condition is rarely fatal under medical treatment, 8 deaths occurred in 24 cases treated by operation, a mortality of 27·5 per cent. Careful examination and interval operation generally reveal chronic appendicitis.

Treatment. Bleeding may take place from (*a*) acute or (*b*) chronic ulcer.

(*a*) **Bleeding from an Acute Ulcer** may be the first abrupt sign of the disease and may be severe. It is rarely fatal, but usually ceases spontaneously, may never recur, and the patient soon recovers from the resulting anæmia. It is clear that no one should advise an operation in such cases, and especially as no visible lesion may be found even when the stomach is opened and carefully examined. In other cases, erosions, weeping areas or minute but deep ulcers have been found. Absolute rest with only a little water and adrenalin chloride by the mouth and rectal salines are generally sufficient. The chances of arrest of hæmorrhage and recovery are much greater without an operation which, experience has clearly shown, greatly adds to the patient's peril. Operation during the bleeding is too dangerous and after it has ceased it is unnecessary and meddlesome for the bleeding may never recur as the ulcer usually heals under careful medical treatment. After serious recurrence an operation should be performed in the interval.

(*b*) **Bleeding from a Chronic Ulcer** is quite different for chronic ulcers heal with difficulty even under careful and prolonged medical treatment, so that an operation in a quiescent period is strongly indicated both to prevent the recurrence of bleeding and to cure the ulceration.

In the majority of cases of gastric ulcer bleeding is slight or even microscopic, causing an increasing anæmia but not a grave emergency. Failing medical treatment an operation is indicated. Usually moderate or severe hæmorrhage is intermittent and it is very rarely wise to operate during an attack, for it is safer to operate early in the interval before a grave or fatal recurrence can take place. When the bleeding has been very severe and especially when the ulcer is thought to be in the duodenum or at the pylorus where large vessels are likely to be eroded, it is wise to operate after one attack. When it has not been very severe complete rest and careful medical treatment should be adopted ; but if the bleeding

[1] *Lancet,* 1906, vol. ii, p. 1189.

recurs under treatment an operation should be undertaken in the interval. Sometimes a large vessel such as the gastro-duodenal, splenic, aorta or vena cava is opened, the patient is so very ill, or death takes place in such a short time that an operation is out of the question. Occasionally when the bleeding is very severe, especially from a duodenal ulcer, and the patient very ill with all the signs of severe hæmorrhage, which do not abate under absolute rest and medical treatment, it is very difficult to know what to do. Whether an operation is done or not the patient will probably die. It is just possible that spontaneous arrest may take place, and it is just possible that a speedy gastro-jejunostomy may snatch the patient from the jaws of death. Here experience and judgment tell, and if an operation is performed, speed and skill are priceless. Nearly always it is safer to wait and operate after the bleeding has stopped and the patient has rallied.

Operation. The incision in the epigastrium must be free, and should in the first instance be median. If this does not give sufficient room the left rectus may be subsequently divided. The stomach and duodenum are carefully examined by inspection and palpation. The stomach is sometimes so distended with gas and blood that a proper examination is impossible until a stomach tube is passed by an assistant. Special attention is paid to the lesser curvature and pyloric regions. A greyish-white depression, induration or adhesion often indicates a chronic ulcer. Occasionally several ulcers are found, sometimes one on the lesser curvature of the stomach, and another in the duodenum. If no ulcer is found on the anterior surface, an opening is made in a bloodless part of the lesser omentum or gastrocolic ligament so that the posterior wall of the stomach may be more easily felt. If bleeding is in progress the ulcer is at once invaginated with two continuous sutures. The first is of strong catgut and pierces all the coats of the stomach after Connell's method about a quarter of an inch away from the edges of the ulcer. When this is drawn tight it should stop all bleeding from the ulcer. A continuous serous suture of linen thread is added. When there are two ulcers both are infolded. If it is difficult to reach and secure a saddle-shaped ulcer high on the lesser curvature, some of the fibres of the left rectus are divided and the left costal margin is retracted, while the lower part of the stomach is grasped and drawn downwards and to the right by an assistant. The coronary artery is tied and the lesser omentum incised so that the posterior part of the ulcer may be brought forward into view and treated as already indicated. When an ulcer on the lesser curvature is widely adherent to or invades the liver, it should not be detached, but if possible the vessels approaching it should be tied. Similarly an ulcer of the stomach or duodenum may invade the pancreas, so that it is impossible to invaginate it in the usual way. In such cases the hæmorrhage is often profuse and the approaching arteries should be tied. The gastroduodenal can be tied just above the duodenum, and the right gastro-epiploic just below the pylorus.

In any case gastro-jejunostomy is performed, for this is very valuable in arresting hæmorrhage, in preventing recurrence of it, and in promoting the healing of the ulcer. When no ulcer can be discovered by careful and speedy inspection and palpation, gastro-jejunostomy is at once performed. The posterior operation is always adopted if possible. Sometimes an ulcer situated low down on the posterior wall may be excised and the opening thus made may be used for the gastro-jejunostomy.

When the patient's condition allows a small accessible ulcer may be excised either before, or better after, gastro-jejunostomy has been performed.

Many other methods of dealing directly with the bleeding area have been tried, but none of them is so speedy, simple and effectual as infolding in the manner described above. Excision, ligation and cauterisation of the ulcer may be mentioned, but even if the bleeding spot is found these methods are difficult and tedious, and add greatly to the patient's peril by increasing shock in a subject already exhausted by hæmorrhage. Exploring the interior of the stomach when no ulcer is feelable is to be especially condemned, for no ulcer or definite bleeding spot may be found, and the operation is unnecessarily prolonged. It is far better to trust to a speedy gastro-jejunostomy alone in these cases, for in the large majority it has been effective. Axillary infusion should be employed towards the end and after the operation.

Sir Berkeley Moynihan [1] has operated 33 times for recurrent hæmorrhage from gastric and duodenal ulcers.

Posterior gastro-jejunostomy was performed in every case save one. In this case the ulcer was excised; the patient died. In twenty-one gastro-jejunostomy was the only treatment adopted; two of these died. Gastro-jejunostomy was combined with excision of the ulcer in two patients, one of whom died. Gastro-jejunostomy with infolding of the ulcer was done eight times, with two deaths. Gastro-jejunostomy with infolding of the pylorus and of the ulcer was performed once; the patient recovered.

Six of these 33 patients died. One of them had cirrhosis of the liver, and no ulcer could be found. One died, collapsed at the end of a week, but the cause of death is not known. One died of pneumonia, one of exhaustion after eleven days, another after three weeks. One died from shock a few hours after the operation. It will be noticed that the mortality of the operation has been 8 per cent. in spite of Moynihan's skill in gastric surgery; but the cases were mostly grave ones, and no recurrence of bleeding took place in any of them. Moynihan now combines infolding of the ulcer with gastro-jejunostomy, and considers this to be the safest and best procedure.

Gastro-jejunostomy by itself has not proved efficient in all cases, for Mansell Moullin and others have recorded cases in which hæmorrhage recurred in spite of this operation. Dr. F. G. Connell [1] has collected 10 cases where gastro-jejunostomy failed in its object. Seven of these ended fatally. Dr. Ticehurst also records two cases in which gastro-jejunostomy was of no avail, and in one of these patients no definite source of hæmorrhage was found either at the operation or after death. The other patient, a young man, died of recurrent hæmorrhage from multiple erosions in spite of gastro-jejunostomy and ligation of many bleeding points. It may be concluded that gastro-jejunostomy is indicated for all cases of severe and recurrent hæmorrhage from gastric or duodenal ulcers, and that an accessible ulcer should be infolded, or when this is impracticable the approaching arteries should be tied.

[1] *Royal Med.-Chir. Soc.*, Nov. 13, 1906.

PERFORATION OF GASTRIC ULCER

PERFORATION of an acute gastric ulcer is a very rare event, but about 10 per cent. of recognised chronic ulcers perforate. In the great majority there is a definite history of gastric symptoms for some months or weeks before the perforation. Frequently there have been more severe pain and discomfort for a few days before the sudden catastrophe. This is probably due to spreading of the ulcer causing inflammation of the peritoneum near it. Although ulcers are more common on the posterior surface of the stomach those on the anterior wall are the most liable to perforate and to give rise to general peritonitis, for posterior ulcers generally adhere to the posterior wall of the lesser sac before they perforate. Thus out of 90 cases admitted for operation the perforation was on the anterior surface in 86 and on the posterior in 11. The perforation of a gastric ulcer may be *acute, subacute or chronic.* A great deal depends on the size of the perforation, the presence of previous adhesions, and especially upon the amount of extravasation and therefore upon the amount of food in the stomach at the time of the perforation. Chronic perforation often leads to adhesion to neighbouring viscera such as the left lobe of the liver or the pancreas. Sometimes a chronic abscess forms, generally in the lesser sac of the peritoneum. In subacute perforation only a small extravasation occurs at the time of the original perforation, which is generally quite small. A localised abscess may then form between the left lobe of the liver and the anterior wall of the stomach. Later the perforation and extravasation may increase or a localised abscess enlarge and rupture into the general peritoneal cavity.

A. **Acute Perforation.** There is no doubt that recovery does sometimes take place without operation. I have seen several of these. One of my patients refused operation and recovered to the surprise of every one concerned. Three months later she died of a second perforation.[1] But recovery without operation is exceedingly rare and is not to be depended upon. The successful treatment of this most serious catastrophe depends upon early, speedy and careful operation. This should be performed as soon as possible after the accident for delay only leads to the escape of more of the gastric contents and to the spreading of peritonitis. With delay the peritonitis becomes more severe in character and paralytic distension of the bowel develops rendering the operation very

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[1] In another instance a man was admitted into an infirmary in a semi-conscious state and was considered too ill for operation. About six weeks later an attempt was made to perform a gastro-enterostomy for the relief of pain, but this was said to be impossible on account of extensive and vascular adhesions. I operated upon him two years later and found extensive adhesions, including a thick and broad sling extending from an ulcer on the lesser curvature attached to the liver round the lower border of the stomach, which was thus drawn up, making the stomach hour-glass in shape. The division of this sling immediately restored the shape of the stomach.

much more difficult.   Moreover with every hour that passes the patient becomes less able to bear the shock of the operation.   The serious results of delay are well shown by the following Table from operations by Moynihan.

	Total cases.	Recovered.	Died.	Mortality.
Operations under 12 hours . .	49	35	14	28·5 per cent.
,, from 12–24 hours . .	33	12	21	63·6 ,,
,, ,, 24–36 ,, . .	16	2	14	87·5 ,,
,, ,, 36–48 ,, . .	2	0	2	100·0 ,,
,, over 48 hours . .	35	16	18	51·5 ,,

Occasionally there is more than one perforation.   Finney states [1] that there is a second perforation in 20 per cent., but the coincidence is far less common in my experience.   The possibility of it should never be forgotten, however, for it is easy to overlook a second perforation into the lesser sac. Gastric and duodenal ulcers sometimes perforate simultaneously.

Diagnosis.   Here a warning is necessary that a great variety of conditions have been mistaken for perforated gastric ulcer, some of which may be mentioned : Perforation of duodenal ulcer, ruptured tubal gestation, painful menstruation, perforative appendicitis, acute hæmorrhagic pancreatitis, thrombosis of the superior mesenteric vein, pneumonia, acute, irritant or ptomaine poisoning, acute dilatation of the stomach, biliary colic, and acute inflammation of the gall-bladder.   It will be noticed that most of these conditions require operative treatment, so that a mistake is only serious as regards the site of the incision and the prognosis that can be given.   In others, an operation can do no harm but may do good ; but in pneumonia, pleurisy, menstruation, &c., the confusion of these with perforated gastric ulcer is almost as serious as the opposite mistake of failing to advise operation for a perforated ulcer.   It may therefore be well to emphasise the leading and really important diagnostic features of perforation of a gastric ulcer.   Too much stress cannot be laid on the history, which is almost constant, *of a sudden onset of dreadful and intolerable pain, especially in the epigastrium, and later becoming general* and even pelvic from trickling down of the escaping fluids.   A sensation of *something giving way* as he is straining is often mentioned by the patient. *Shock of a severe degree* sometimes follows and is characteristic when seen, but the patient is often better with normal pulse and temperature when the doctor arrives.   *The pulse rate usually falls immediately after the perforation and then gradually rises.   A quickening pulse is of the gravest significance.* The temperature usually falls at first and gradually rises.   *A contracted, rigid, tender abdomen* is the most important of all and is found in spite of morphine foolishly administered for the relief of pain.   Later, of course, it will be full and tympanitic.   The respirations are shallow, catchy, and hurried, hence the mistake of diagnosing pneumonia in some cases. *Vomiting* occurs in about half the cases, and the great majority give a history of indigestion or more serious gastric troubles.

Pneumonia and pleurisy should be always considered.   A rub, râles, or disproportionately quick respiration rate with a rapidly rising temperature and flushed face suggest pneumonia.

Operation.   The operation itself includes : (i) Finding the perforation ; (ii) Successfully closing it ; (iii) Efficiently cleansing and draining the peritoneal sac—headings which will be taken separately.   No operation

[1] *Ann. of Surg.*, July 1900.

calls for greater speed and care.   When everything is absolutely ready and the patient anæsthetised an incision five inches long is made from near the right costo-xiphoid angle to the level of the umbilicus and through the rectus sheath.   The falciform ligament is thus avoided.   When the peritoneum is opened an escape of odourless gas is not uncommon, sometimes of fluid consisting partly of the last meal taken and partly of straw-coloured serous effusion from the irritation of the peritoneum.   This is usually sterile in the early stages.   If the fluid is bile-stained the perforation is probably in the duodenum.   If there is no such escape the outlook is so far more favourable, as it may be hoped that as yet the extravasation is slight and limited to part only of the peritoneal sac.   If this be so, though it is uncommon, the surgeon should shut off the lower part of this sac as far as possible with gauze packs before he disturbs the stomach and its surroundings.   In all cases immediately after opening the abdomen I pass gauze rolls into the loins and pelvis.

(i) **Finding the Perforation.**   This varies very much in difficulty. Sometimes the eye detects it at once when the stomach is drawn downwards and the edges of the wound are well retracted.   Gas often bubbles and sizzles out of the perforation.   At other times the exploring finger, passed along the lesser curvature, soon feels it or the area of induration which forms the base of the ulcer.   In other cases finding the ulcer is beset with the greatest difficulty, or, owing to the hurried search which alone is possible from the state of the patient, is quite impossible.   In a difficult case help may be obtained by tracing the direction in which the congestion of the stomach appears to be increasing, by watching the direction from which any flow that may be present is coming.   The liver should be raised by an assistant, and the stomach drawn downwards and to the right, while the whole of the anterior surface and the lesser curvature are carefully examined with a good light.   Adherent lymph or adhesions between the stomach and liver may mark the site of the perforation, and may require gentle separation before it is revealed.   The perforation itself may be extremely small, and thus easily hidden by any fold of the stomach, still more readily by lymph and adhesions.   The greatest difficulty may be experienced with a perforation high up on the lesser curvature close to the œsophagus.   In these cases it may be necessary and of great assistance to divide some of the upper fibres of the left rectus. In some cases no perforation may be discovered until the lesser omentum is incised and the posterior surface of the stomach thus examined.[1]

(ii) **Closing the Perforation.**   If possible the perforated part of the stomach is brought well forwards into the wound, and held there by the left hand.   Gauze packs are introduced to absorb the effusion which often wells up and obstructs the view.   Sometimes when the stomach is full and tense, the stomach tube is passed by an assistant to empty it at once. A single perforating suture of silk or linen thread is passed to close the

[1] Mr. Dunn's case well shows how difficulty here is to be met:
  On separating the adhesions which fixed the liver to the abdominal wall, a quantity of opalescent fluid escaped.   The liver was then pulled upwards and the anterior wall of the stomach pushed backwards, and now it was that some brownish fluid like weak coffee, containing gas-bubbles and one or two small masses of coagulated milk, escaped. It welled up from a considerable depth, at the left of the incision, and was found, on subsequent examination, to be strongly acid, and to contain a little albumen.   Several more adhesions were broken down, but still no perforation could be seen, and it was only when the left margin of the wound was stretched outwards to the utmost, whilst steady traction was made upon the stomach towards the right, that the hole in this viscus became visible.
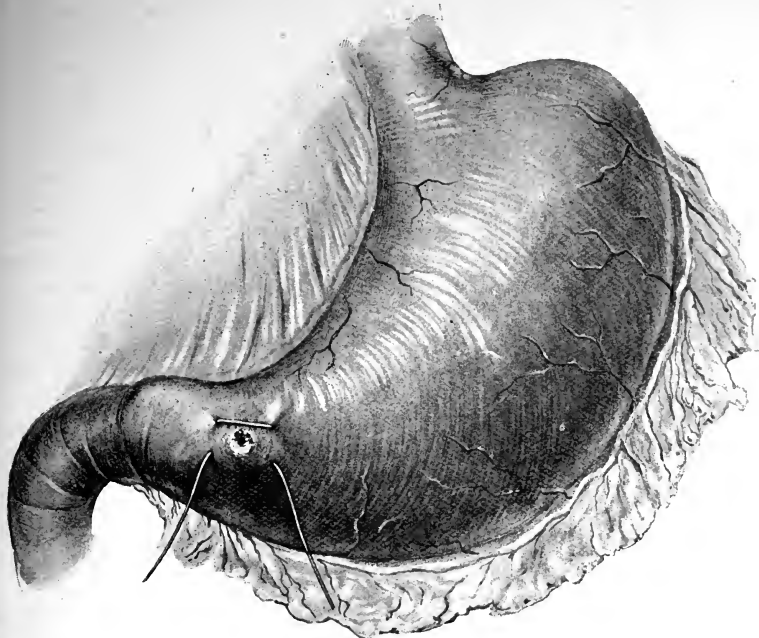
FIG. 73. Closing the perforation. The suture pierces all the coats at a healthy supple part beyond the ulcer.
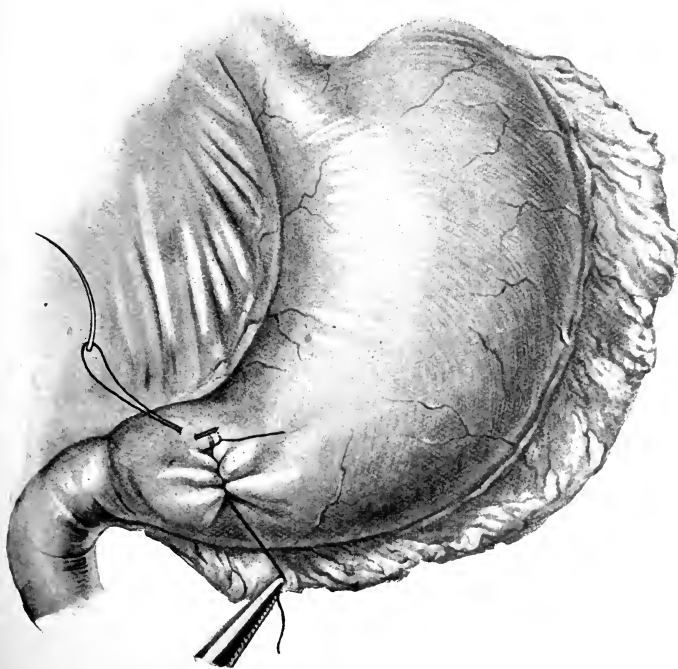

FIG. 74. The sero-muscular suture. The sutures are passed from side to side so as to avoid narrowing of the lumen.

perforation and stop further leakage (*see* Fig. 73). This is invaginated by a continuous sero-muscular suture which begins and ends well above and below the extremities of the perforation (*see* Fig. 74). When the ulcer is near the pylorus it is particularly important to pass the sutures from side to side and not from above downwards, so as to avoid narrowing of the outlet of the stomach. Fortunately it is easier to pass them in this direction than from above downwards. They should be inserted far enough from the margins of the perforation to ensure a safe hold and sufficient inversion of the serous surfaces. In many cases a tag of omentum is brought over the site of perforation and secured in position by a few sutures. Occasionally it is very difficult or impossible to close the perforation in a reasonable time. Then a wick of gauze extending through a split rubber tube down to the perforation answers almost as well and possibly better in some cases. Since 1908 Mr. Corner has used the method on fifteen occasions without losing a case.[1]

Perforation into the Lesser Sac of the Peritoneum. Fortunately perforations of this surface are very rare for they are difficult to discover and to close. In 5 out of 42 cases reported by Crisp Inglis [2] the perforation was on the posterior wall close to the pylorus and in 10 per cent. of the 112 cases collected by Paterson [3] the ulcers were on the posterior surface of the stomach. If the evidence of perforation is strong and nothing can be found on the anterior surface of the lesser curvature, an opening is made in a bloodless part of the lesser omentum and the anterior wall of the stomach is invaginated and pushed upwards thus bringing the posterior surface into view. In nearly all these cases the perforation will be found near the pylorus.

In a case under the care of Dr. L. E. Shaw, Mr. Jacobson adopted this plan. The operation was performed seventeen hours after the perforation. As no perforation could be found on the anterior surface of the stomach, the lesser omentum was carefully torn through and the posterior surface explored. A small, recent-looking ulcer was found near the lesser curvature, with a small perforation in its centre. With considerable difficulty six Lembert's sutures were inserted so as to invert the ulcer. Irrigation was not performed, but free drainage was employed, a tube being placed in the pelvis, and a tube and gauze strips passed down to the lesser curvature. The patient made a good recovery.

Excision of the Ulcer. The excision of a perforated ulcer is not recommended for it consumes much extra time, causes a good deal of additional hæmorrhage, and converts the perforation into a large gap requiring numerous sutures to close it. Moreover experience shows excision to be unnecessary for healing.[4]

Primary Gastro-jejunostomy. Anterior gastro-jejunostomy was first performed for perforated gastric ulcer by Braun.[5] The patient recovered

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[1] *Lancet*, 1913, vol. i, p. 600.

[2] *Medico-Chir. Trans.*, 1903, vol. lxxxvii.　　　　[3] Hunterian Lectures.

[4] St. Clair White (*Brit. Med. Journal*, Feb. 20, 1904) reports five consecutive cases in which the ulcer was excised and the aperture closed with two layers of sutures, fortified by an omental graft. Two of these cases died some time later as a result of ulceration at the line of suture. One died a fortnight after the operation from profuse and repeated hæmatemesis. The other death, which occurred after six weeks, was due to a small abscess in the stomach and secondary multiple hepatic abscesses. Mr. Mothersole (*Lancet*, 1905, vol. ii, p. 223) records two cases in which he succesfully excised the ulcers near the pylorus, and in each case he sutured the wound in such a way as to widen the pylorus. About four months later the patients were quite well. Mr. Mitchell (*Brit. Med. Journal*, 1905, vol. ii, p. 779) and Mr. Anderson (*Lancet*, 1905, vol. ii, p. 944) found that excision of the ulcer did not give permanent relief, however. In Mr. Anderson's patient, symptoms of ulceration returned after a year, and gastro-jejunostomy had to be performed after sixteen months ; this gave complete relief.

[5] *Centralblatt für Chirurgie*, Leipsic, 1897, p. 739.

and remained well for several years. It is now generally recognised that the posterior operation is far more efficient and it may be performed in selected cases, *i.e.* when the condition of the patient is good, the surgeon quick and capable, and the perforation at or near the pylorus or in the duodenum, where closing the perforation or the contraction of a large healing ulcer may lead to obstruction. About one-half of perforated ulcers are in this area, but only a few of them call for primary gastro-enterostomy. It may also be performed for very extensive ulceration in this neighbourhood and when there are more than one perforation or great difficulty in closing a perforation. This step has also been recommended in order to avoid immediate or subsequent dangers, or troubles from persistence of ulceration, hæmorrhage, secondary perforation of the same or of another ulcer. The most important and, to my mind sufficient, objection is that many of these patients are not in a condition to stand a prolongation of the operation when they come for treatment. To save life it is enough to close the perforation and drain the abdomen. If a gastro-jejunostomy becomes necessary it is safer in the majority of cases to do it as a secondary operation. Experience shows that this is not often necessary. The following figures are quoted by Corner : [1]

	Satisfactory.	Unsatisfactory.
French, 18 cases (*Guy's Hosp. Reports*, 1907, vol. lxi)	83 per cent.	17 per cent.
Crisp English, 17 cases (*Transactions of the Royal Medical and Chirurgical Society*, 1903) .	65 ,,	35 ,,
Paterson, 33 cases (*The Lancet*, vol. i, 1906, p. 575)	48 ,,	52 ,,
Morton, 11 cases (*Brit. Med. Journ.*, 1910) . .	30 ,,	70 ,,
Rendle Short, 23 cases (*Bristol Medico-Chirurgical Journal*, Sept. 1911)	34 ,,	66 ,,
Corner, 40 cases (*Royal Society of Medicine*, 1913) .	33 ,,	67 ,,

The great variation in these estimates is due to widely different views as to what is really satisfactory. It is fair to conclude, however, that at least one third of the surviving cases are really cured, so that a primary gastro-enterostomy could have done them no good, but might have done them harm. Corner argues that as about 50 per cent. of perforated ulcers are well away from the pylorus and duodenum where stenosis is not likely to develop, gastro-enterostomy is not required in as many as 50 per cent. of the cases. It must not be forgotten, however, that ulcers on the lesser curvature are often slow in healing, cause severe pain and sometimes end in hour-glass contraction ; also that gastro-enterostomy undoubtedly helps them to heal. I agree with the following conclusions of Mr. Corner.[2]

" To sum up the results of my examination of some 40 cases and five years of literature, it would seem that :

" (1) Many subjects of the perforation of a gastric ulcer are benefited by a gastro-enterostomy. This is particularly true if the perforating ulcer is in the neighbourhood of the pylorus, gastric or duodenal.

" (2) It would appear, speaking generally, that a secondary gastro-enterostomy—*i.e.* after the patient has recovered from the immediate danger of the perforation—is better than a primary gastro-enterostomy.

" (3) It is better for the patient to have a secondary gastro-enterostomy

[1] *The Lancet*, March 1, 1913, p. 601.
[2] *Loc. supra cit.*

when it is required than have the additional danger of a primary gastro-enterostomy which may not be needed.

"(4) It has not been shown that a primary gastro-enterostomy presents such advantages over a secondary gastro-enterostomy that it, the primary gastro-enterostomy, should be practised in the treatment of the perforation of ulcers even when situated in the neighbourhood of the pylorus."

Ellsworth Eliot [1] comes to similar conclusions in a valuable paper.

When abdominal symptoms develop and persist in spite of medical treatment, the patient should be very carefully examined before advising gastro-enterostomy. Particular attention should be paid to the possibility of appendix dyspepsia, and in all cases the stomach should be examined by the bismuth and X-ray method before concluding that there is stenosis. When the symptoms justify an operation it should always commence as a thorough exploration. The appendix should always be examined and removed if time permits.

Washing out the Stomach. When the stomach is very full at the time of the operation it is a distinct advantage to wash it out directly the perforation has been closed, for it makes the patient much more comfortable, allays vomiting, promotes healing and allows earlier feeding.

(iii) **Cleansing the Peritoneal Sac.** Though most stress has been laid upon the point of efficient suturing of the perforation, there is no doubt that this one is important.

Early Cases with Local Extravasation. In the majority of cases where the extravasation is limited or clear and sterile as it is in early cases, it is wiser not to irrigate, as this may do more harm than good. The soiled portion of the peritoneum should be gently cleansed with moist sterilised gauze rolls, which are passed in various directions as soon as the abdomen is opened. One end of each roll is always clipped to the towels. These rolls rapidly absorb the fluid and thus greatly assist the surgeon in finding and closing the perforation. As it is not always easy to tell the extent of the soiling, it is wise to examine the kidney pouches, sub-diaphragmatic spaces and the pelvis in every case.

In a few later cases with Diffuse Peritonitis irrigation is indicated because of the extensive degree of the extravasation of the stomach contents. Irrigation is quicker than other ways of removing this foreign material and creates less disturbance and shock than *extensive* mopping would induce. The fluid used should be boiled water or normal saline, *e.g.* sod. chlor. ʒj—Oj of boiled water at a temperature of 105°. If no irrigator is at hand sterilised india-rubber tubing attached to a funnel will answer very well. The rubber tube is passed between the liver and diaphragm on each side of the falciform ligament, then below the liver about the stomach and down each flank amongst the coils of small intestine, and finally into the bottom of the pelvis. It is an advantage to make a small wound about two inches above the pubes, care being first taken to ascertain that the bladder is empty. This plan facilitates the irrigation, especially when a tube is passed through the puncture. The irrigation can be carried on during the greater part of the operation.

Drainage. Before closing the abdominal wound the question of drainage will arise. The necessity for this largely depends upon the particular conditions found at the operation. If the case has been operated upon early and if the amount of extravasation is small or non-purulent it is sufficient to cleanse the soiled area with moist gauze, the abdomen being

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[1] *Ann. of Surg.*, 1912, vol. i, p. 563.

closed without drainage. In a few doubtful and late cases, however, temporary drainage is safer. If there is late peritonitis implicating practically the whole abdominal cavity, a tube should be passed down into the pelvis through a small incision above the pubes. The exploratory incision is usually closed in layers. No drainage tube is passed near the perforation, but in some bad cases one is directed towards the right kidney pouch. Wilkie[1]
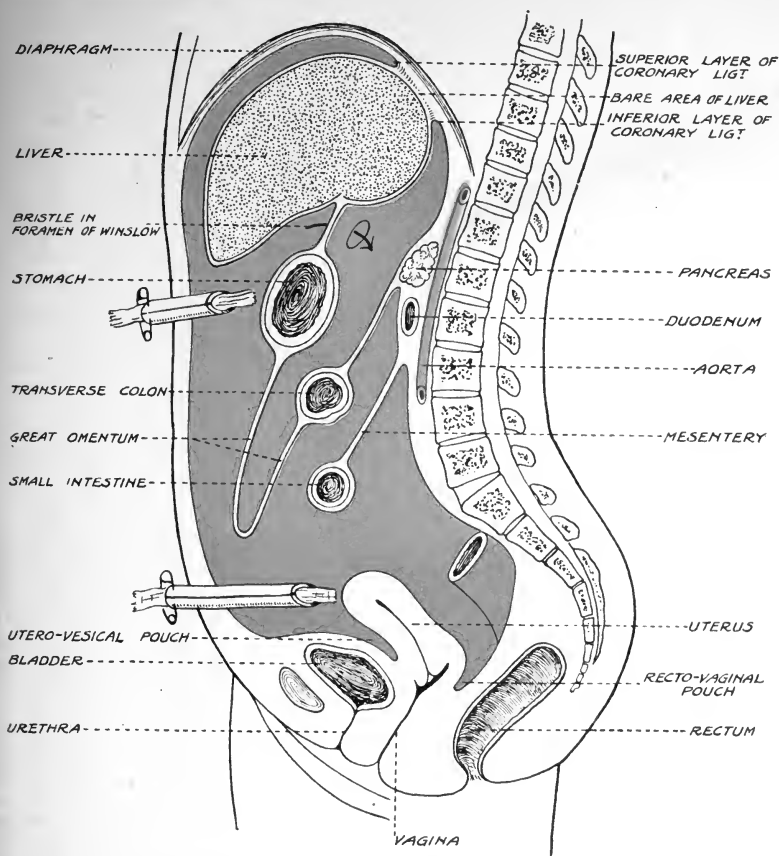

FIG. 75. Epigastric and suprapubic drainage for peritonitis. The gauze in the suprapubic tube should extend back into the pouch of Douglas.

has shown that the careful immediate examination of stained films of the peritoneal exudate, may enable us to estimate the degree of the patient's resistance, and the virulence of the bacteria for the particular patient. This may be of great value in deciding for or against drainage and in giving a prognosis. The semi-sitting attitude should be adopted as soon as the patient is round from the anæsthetic, to promote drainage and to lessen the risk of pulmonary complications and sub-diaphragmatic abscess. Rectal salines are employed for at least twenty-four hours, nothing but water being given by the mouth during the first twelve hours. Then milk and water are given in increasing quantities. No purgative is given for three days, but the rectum is washed out every morning, and a turpentine enema is given if there is much distension.

The mouth is frequently rinsed out with water and cleansed with an antiseptic milk solution. These patients require careful dieting and should be kept under observation for some time. If signs of ulceration or of dilation of the stomach develop secondary gastro-enterostomy should be performed. The following three cases are good examples of this condition. The first was a large perforation near the pylorus treated after five hours. The second had a perforation of an ulcer near the œsophagus leading to extravasation to the left kidney pouch spreading to the left iliac fossa and pelvis. This condition can be easily overlooked when the usual incision is made to the right of the middle line. The third patient, an old man, came too late for recovery and died from septicæmia.

The first case was that of a young man of 23 who was walking home hungry over the Tower Bridge when he was suddenly seized with such a severe pain in his abdomen that he was obliged to lie down on the pavement. He was promptly brought up in a collapsed condition to Guy's Hospital. His condition soon improved, however, and then he refused operation because he could not be persuaded of his peril. He wished to consult his mother first, but she lived far away. At last he consented, when his condition was compared with that of a drowning man who declined to grasp a rope until he had obtained his mother's sanction. The patient gave a history of an attack of appendicitis. The pain, tenderness, and rigidity in the present illness was more marked on the right side near the appendix, and there was impaired resonance in the right loin. An incision was made through the right rectus at a higher level than is adopted for appendicular cases, because it was felt that the very sudden and severe onset was very suggestive of perforation of the stomach. Turbid serum was found in the iliac fossa, but the appendix was not diseased; the incision was enlarged upwards, and a good-sized round gastric perforation was found near the pylorus and closed with Lembert sutures. On account of the extensive extravasation, free irrigation was employed, followed by the insertion of cigarette drains, one between the stomach and the liver and another in the right kidney pouch. The patient was quite well nine months later.

The second patient was a girl of 19, who had suffered severely from indigestion for six months. She also gave a history of a sudden and agonising pain, but it was situated chiefly in the left hypochondrium. She was given a dose of morphia to enable her to travel in comparative comfort from a fever hospital to Guy's. An incision made through the right rectus as high up as possible disclosed a collection of sero pus and gastric contents between the liver and the stomach and also travelling down towards the left kidney pouch. A perforation was discovered on the anterior surface close to the lesser curvature, very near the cardiac orifice. The stomach was drawn downwards and to the right, and an assistant held the left costal margin upwards, while another retracted the liver; and after much trouble the perforation was closed by inversion, and a loose flap of fatty lesser omentum was turned down and secured over the sutures. The ulcer was a chronic one of large size with thick walls, so that inversion was not easy, apart from the depth. Irrigation was not adopted because the extent of extravasation was not great, and dry swabbing was used instead. A cigarette drain was left in front of the stomach near the perforation. The patient recovered.

A third case was that of an old man of 62, who was admitted into Guy's Hospital over four days after the perforation had occurred and after a long journey by train. He had general suppurative peritonitis with tympanitis. The peritoneum was rapidly cleansed by dry mopping, and the ulcer, which was near the pylorus, was closed by inversion with a continuous Lembert's suture. Cigarette drains were placed, one near the perforation and another in the pelvis. The operation only took twenty minutes, and the patient stood it very well, but he died three days later, after seeming to do well for two days. He occasionally brought up some black vomit (altered blood), however. At the autopsy there was no collection of pus in the peritoneum; two acute ulcers were found, one on the posterior wall, which was not perforated, and the other on the anterior wall, which had been satisfactorily closed at the operation.

Causes of failure.—(1) *Acute Septicæmia from peritonitis* existing before, and not cured by, the operation. This has been the most frequent cause of death.

(2) *Failure to find or to close the perforation*. The following case reported by Mr. Jacobson many years ago illustrates both these causes of failure.

Operation was refused at first when urged upon the patient, and it was not until the third day, when the abdomen was greatly distended, tympanitic and motionless, that the patient and her friends, seeing how hopeless the case was getting, gave their consent. When the abdomen was opened the stomach itself was greatly distended. The peritoneal sac, especially at its upper part under the liver, between this and colon, spleen and kidneys, was filled with purulent fluid, in which the more solid part of the last meal taken (Scotch broth) could be seen floating. All the viscera seen were thickly scattered with thick, yellowish, flaky lymph. This was especially present, together with numerous soft adhesions, between the lesser curvature and the liver. Had I broken down and searched amongst these I should have found the ulcer,[1] but the anterior surface being sound and the stomach greatly distended, I examined the duodenum and found, as I thought, a minute perforation, a softened spot on the anterior and inner part of the first portion, into whch a probe passed. This I sutured, and sponged and washed out the peritoneal sac. The patient was in a most critical state at the time of the operation, and sank thirty-eight hours after. At the necropsy a perforation was found on the lesser curvature.

(3) *Shock* of the operation and anæsthetic. This can be largely prevented by quick operating and by adopting the other precautions mentioned at p. 8. Soon after the operation infusion is often of great use.

(4) *Sub-diaphragmatic abscess* causing septicæmia or leading to pulmonary complications.

(5) *A second perforation*. This is stated by Finney to be present in 20 per cent. of the cases, and a careful search should therefore always be made for a second ulcer. Again, a second perforation may take place after the operation, for when the ulcer is very large another spot may give way, probably from softening set up by the local inflammation due to suturing.

Mr. Gould [2] mentions a case of Mr. Pepper's in which a perforation had been sutured. For three days the patient did well, when she suddenly became collapsed and quickly died. The necropsy showed that the perforation which had been sutured was in the front part of an ulcer the size of a crown-piece, the line of suture being perfect and water-tight, but that a second perforation had occurred at its posterior part.

(6) *Hæmorrhage* from the same or another gastric or from a duodenal ulcer.

B. Subacute Localised Abscess due to Perforation of a Gastric Ulcer. The perforation may be very small or the stomach may be empty at the time of the perforation, so that only a comparatively small extravasation occurs, which may be walled off by adhesions for a time. I operated on a case of this kind under considerable difficulties with Dr. Gardiner at Dunmow. The perforation had occurred about forty-eight hours before the operation, at which a collection of pus was found between the liver, the anterior surface of the stomach, the abdominal wall and the upper half of the great omentum. A small perforation was found near the pylorus; this was closed and the pus was mopped up and drainage employed. The patient recovered, and was well seven years later.

The Mortality of Perforation of a Gastric Ulcer. From the following

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[1] No surgeon should leave these unexplored in the hope of a natural cure. This, if accomplished, will very likely be so at the cost of a sub-phrenic abscess and septicæmia. *See also* the remarks above.

[2] *Brit. Med. Journ.*, vol. ii, 1894, p. 861.

statistics it will be seen that there has been a progressive improvement in the results of operations for perforating gastric ulcers. This is due to earlier operation and better methods. Mr. Crisp English,[1] in a valuable paper, published the results of 50 consecutive operations for perforation of gastric and duodenal ulcers. The operations were performed by many surgeons at St. George's Hospital from 1892 to 1903. Out of the 42 cases of gastric perforation 52 per cent. recovered, only 3 of the first 10 recovered, but 6 out of 7 recovered in 1903.

Mr. Paterson [2] collected 112 consecutive cases from the records of two London hospitals, with a mortality of 52 per cent. ; and through the registrars of fourteen London hospitals he found that 143 operations were performed in 1910, with a mortality of 44 per cent. It should be remembered that patients in the poor districts of London still come to the hospitals very late. Mr. Sargent [3] states that 49 cases were treated by operation at St. Thomas's Hospital up to 1904 ; 58 per cent. of these recovered after suture and peritoneal lavage. The average time that had elapsed before the successful operations was twenty-three hours, and before the failures 32·6 hours.

Moynihan [4] records 27 operations for perforated gastric and duodenal ulcers, with 18 recoveries (66·6 per cent.). In 6 of these cases gastro-jejunostomy was performed immediately after the closure of the perforation, with 5 recoveries.

T. S. Kirk [5] records 11 cases, in 10 of which the operation was performed between a quarter of an hour and ten hours after the perforation, and all recovered.

Mr. G. R. Turner and Mr. Crisp English [6] publish 9 cases of perforated gastric ulcer with 8 recoveries. Very free irrigation and drainage were employed in 8 of these cases.

Morton [7] reports 10 cases with a mortality of 30 per cent.

Carwardine [8] reports 12 cases with a mortality of 9 per cent. At the present time the average mortality should not be above 25 per cent. ; it is certainly less than this in the private practice of experienced surgeons.

C. **Chronic Abscess due to Perforation of a Gastric Ulcer.** Instead of sudden perforation, with escape of the contents of the stomach into the general peritoneal cavity, the perforation here is associated with the formation of adhesions and the production of a localised abscess. This may be brought about in several ways. In some cases the base of the ulcer becomes adherent to a viscus—liver, spleen or pancreas—subsequent perforation giving rise to an abscess which slowly burrows first into and then beyond the viscus involved. In other cases, the perforation is preceded by a plastic peritonitis resulting in the formation of adhesions, which thus limit the diffusion of gastric contents when perforation occurs. Again, the leakage of gastric contents may at first only take place quite slowly, owing either to the small size of the perforation, to the stomach being empty at the time, or to the perforation taking place during the night. The abscess so produced is in most instances of the *sub-phrenic* variety, the majority of which are caused by gastric ulcers.

Sub-phrenic Abscess due to Perforation of a Gastric Ulcer or other causes. The limits of this abscess vary according to the site of the

[1] *Med.-Chir. Trans.*, 1903, vol. lxxxvii.
[2] *Loc. supra cit.* and *Gastric Surgery*, 1913.
[3] *St. Thomas's Hospital Reports*, 1904.   [4] *Med.-Chir. Trans.*, November 1906.
[5] *Med. Press*, March 20, 1903.   [6] *Lancet*, vol. ii, 1904, p. 145.
[7] *Brit. Med. Journ.*, Jan. 29, 1910.   [8] *Lancet*, Jan. 22, 1910.

perforation, as will be understood by reference to the accompanying illustrations. Fig. 76 shows the boundaries of an abscess produced by perforation of an ulcer in the anterior wall of the stomach. It will be seen to be limited below by adhesions between the great omentum
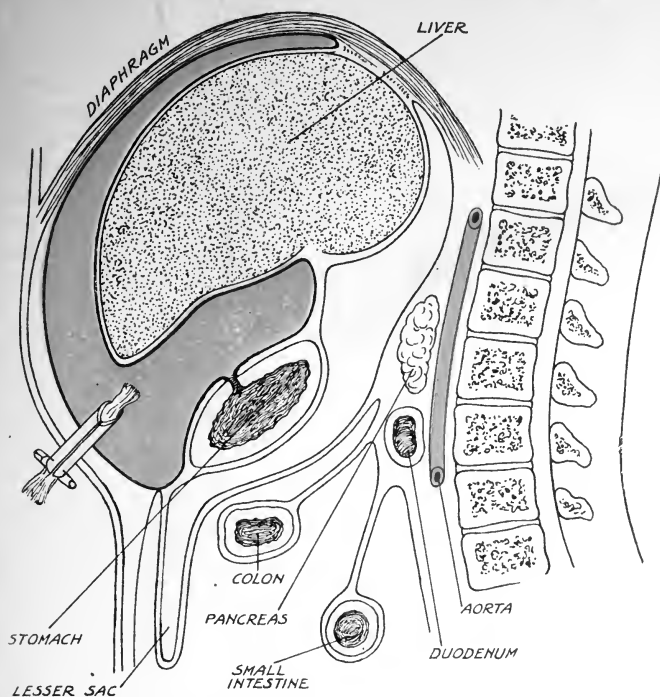

FIG. 76. Anterior subphrenic abscess from perforation of an ulcer in the anterior wall of the stomach.

and the anterior abdominal wall, and above by the diaphragm and anterior layer of the coronary ligament of the liver. Usually the abscess involves one side only, being bounded internally by the falciform ligament of the liver. When secondary to perforation of a gastric ulcer the abscess is nearly always on the left side. In Fig. 77 is shown an abscess produced by a perforation in the posterior wall of the stomach. Here the abscess cavity involves the lesser sac of the peritoneum, the foramen of Winslow being occluded by adhesions. The third variety, shown in Fig. 78, will be seen to be in reality a retro-peritoneal abscess. Such an abscess will be caused by a perforation in the posterior wall of the stomach, where the two walls of the lesser sac of the peritoneum have previously become adherent, or, in some cases, by per-foration of a duodenal ulcer. Although perforation of a gastric or duodenal ulcer is the commonest cause of sub-phrenic abscess, other causes may be mentioned. Of these appendicitis is the most frequent, especially neglected cases with suppuration, where no operation is performed, or only performed very late. This complication is particularly liable to develop when there is suppuration in the loin, especially retro-cæcal. It may also follow leakage of infective material upwards and backwards during an operation for appendicular abscess unless care is taken to
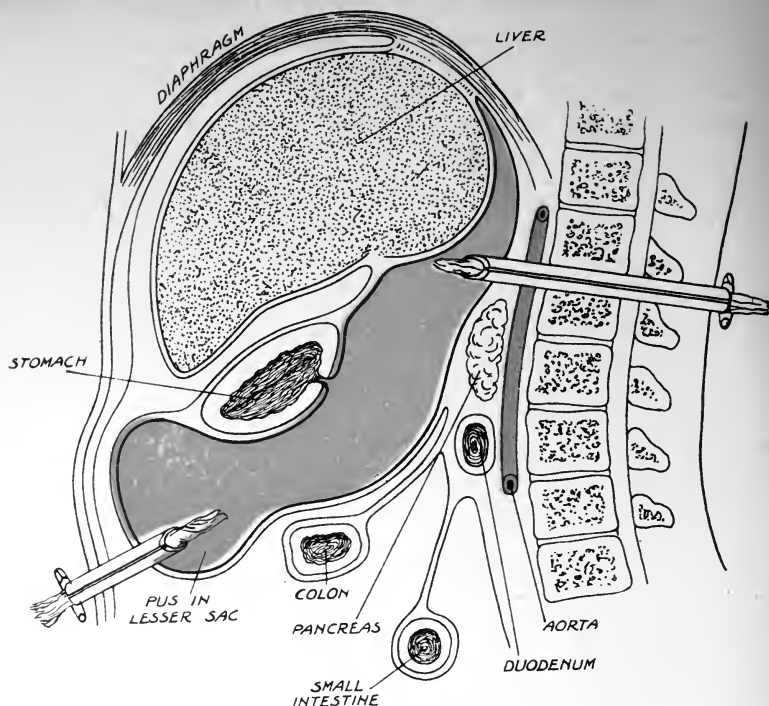
FIG. 77. Posterior subphrenic abscess in the lesser sac of the peritoneum. Drainage-tubes are showing front and behind.
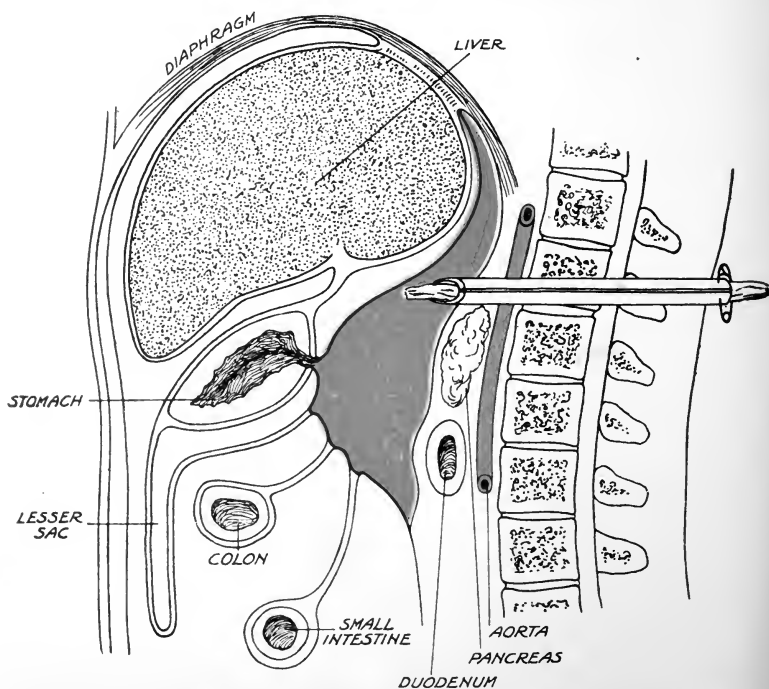
FIG. 78. Retro-peritoneal subphrenic abscess from a gastric ulcer adherent to the back of the lesser sac.

introduce a pack into the loin above the abscess before the latter is opened. Occasionally disease of the kidney gives rise to sub-phrenic abscess, and in one case after draining an empyema I opened a presenting sub-diaphragmatic abscess through the diaphragm from above, and, thus removed a large renal calculus. Other less common causes are disease of the intestines, especially of the colon, carcinoma of the stomach, hepatic abscess, pancreatitis, splenic abscess, hydatid, and pyæmia.

Diagnosis.—Remittent or intermittent fever with rigors, rapid wasting, anæmia, increased dulness at one base of the chest, and expansion of the lower part of the chest are to be found in some cases, and occasionally local tenderness and œdema. There may also be pulmonary signs, especially of pleurisy and empyema. Especially when of gastric origin the abscess may contain gas ; then there may be below the normal pulmonary resonance, dulness due to pleural effusion, and below this a resonant area due to gas under the diaphragm, and lower still there is dulness over the pus, liver and spleen. An X-ray examination is of great value, but I have known it mislead on several occasions, twice on the left when the stomach was confidently proclaimed to be a sub-diaphragmatic abscess, and once on the right the retraction of a chronic pneumonic lung drew the diaphragm and liver up in a curious cone-shaped process closely simulating sub-diaphragmatic abscess. In each case a hand passed through an epigastric incision proved the absence of an abscess. A long exploratory needle of large calibre is used to confirm the diagnosis in nearly all cases, but it often fails to withdraw pus, which may be so thick as to block the needle. Once I struck pus at the twelfth attempt. When grave suspicion of sub-diaphragmatic abscess exists, and when other means fail to discover it, the abdomen must be opened in the epigastrium, and a hand introduced. In a few seconds this serves to reveal and accurately locate an abscess, which can be drained at a suitable point generally from behind, the anterior wound being completely closed. In other cases the exploration reveals some other hidden cause of pyrexia such as hepatic or splenic abscess.

Operation. (1) *Thoracic Incision.* The great majority of sub-diaphragmatic abscesses are postero-superior and are most accessible from behind, and the excellent rule given by Barnard is to find the pus with a large needle and then to follow the needle when incising for drainage. By the time the operation is performed the pleura is usually affected, being inflamed, and either adherent or containing serous or even purulent effusion. In most of these cases it does little harm to go through the pleura in reaching the abscess. When there is an empyema it is obviously an advantage to go through the pleura. On the contrary when the pleura is healthy as it is in early cases, it is clearly an advantage to avoid all chance of pneumo-thorax and infection of the pleura. In these cases an attempt should always be made to reach the abscess below the pleural reflection. Portions of one or more of the lower ribs at a site below and in front of the reflection of the pleura can be selected and removed without danger, and good drainage obtained (*see* Fig. 79). Occasionally a *large* abscess can be opened below the last rib in the loin. When the parietal pleura is exposed and seen to be healthy and movable on the visceral or diaphragmatic pleura, it is at once sutured to the diaphragm to prevent infection and pneumo-thorax. An incision is then made through the pleura and diaphragm within the protective area (*see* Fig. 80). A finger is introduced to find the abscess which, when opened, is drained with a
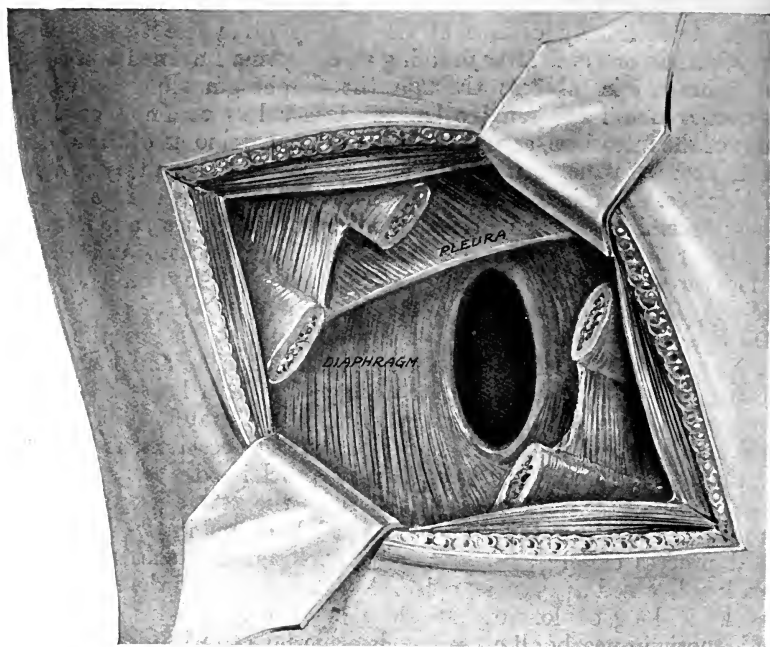
Fig. 79. Opening sub-diaphragmatic abscess from behind below the pleural reflection.
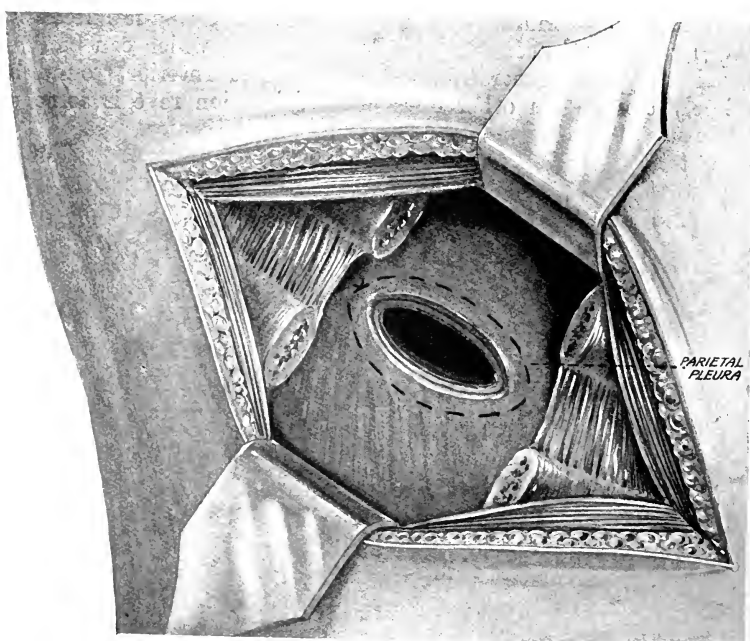

Fig. 80. Opening sub-diaphragmatic abscess from behind through the pleura. The pleural cavity is sealed off by continuous suture of the parietal and diaphragmatic pleuræ.

large rubber tube. This is sewn to the skin so that it may not get dislodged.

(2) In some cases *an oblique incision* is made at a suitable spot *parallel with the costal margin*, and the abscess found through this incision and drained either here or through a counter incision in the loin. If the peritoneal cavity is opened before the abscess is found, a gauze pack is carefully placed to protect the peritoneum before the abscess is opened.

(3) In a few gastric cases a sub-diaphragmatic abscess bulges in the epigastrium and calls for *a vertical incision* here. Should the abscess involve the lesser sac of the peritoneum, it may be opened through the gastro-hepatic or gastro-colic omentum after the general peritoneal cavity has been shut off by careful packing with gauze, but it is sometimes better to drain it through the left loin. The contents of a sub-diaghragmatic abscess are frequently most offensive, so that the cavity has to be syringed with hydrogen peroxide or a weak solution of sodium hypochlorite.

The *prognosis* of sub-diaphragmatic abscess has greatly improved in recent years partly owing to earlier diagnosis and more radical treatment. The mortality may be estimated to be about 30 per cent. at the present day, whereas it was as high as 50 per cent. twenty years ago. Without operation the mortality is about 95 per cent.

PERFORATION OF DUODENAL ULCER

This occurs much more frequently in men than in women. The symptoms and the treatment of this condition differ considerably from those of perforating gastric ulcer, because of the site of the perforation in the first part of the duodenum, and within the right kidney pouch of the peritoneum in practically every case.

Mr. Rutherford Morrison described and drew attention to the importance of this pouch in 1894.[1]

Mr. Moynihan,[2] in a valuable paper, pointed out the direction in which extravasated fluid travelled from it towards the appendix, giving rise to symptoms closely simulating those of appendicitis. In the 51 cases collected by him a correct diagnosis was only made in 2, whereas the primary incision was made over the appendix in 19 cases. Mr. Maynard Smith[3] gives an interesting account of an experimental and clinical study of the anatomy and pathology of the kidney pouch, and its bearing on perforating duodenal ulcer. The limits of the pouch are : *in front,* the lower surface of the right lobe of the liver and the hepatic flexure of the colon ; *behind,* the peritoneum covering, the right kidney, and the posterior abdominal wall which slopes backwards and outwards from the spine, determining the flow of liquid away from the foramen of Winslow, which with the duodenum forms the inner boundary. The abdominal wall forms the outer limit ; above, the pouch extends behind, to the right and in front of the right lobe of the liver. The lower boundary is less complete, consisting partly of the beginning of the transverse mesocolon, as it stretches back to the kidney and second part of the duodenum ; to the outer side of this a leak may occur. Maynard Smith found that liquid which had been introduced into the kidney pouch through a perforation in the duodenum, overflowed downwards along the outer border of the colon towards and ultimately

[1] *Brit. Med. Journ.*, 1894, vol. ii, p. 968.
[2] *Lancet,* 1901, vol. ii, p. 968.
[3] *Ibid.* 1906, vol. i, p. 895.

over the pelvic brim, and in cases with short ascending mesocolon, the fluid passed forwards over the front of the ascending colon near the liver, and then passed downwards towards the lower end of the ileum and cæcum ; the obliquity of the mesentery and the prominence of the spine preventing any flow towards the left until the pelvis had been flooded.[1]

These facts have an important bearing upon the diagnosis and treatment of perforating duodenal ulcer. Such perforations may be roughly divided into acute, subacute and chronic.

In the acute a large ulcer may tear away from adhesions and a copious extravasation may occur, leading to a diffuse peritonitis. In other cases the extravasation may be small in amount and become limited temporarily or permanently in the kidney pouch.

SYMPTOMS AND SIGNS

In nearly all the cases, there is a history of a sudden onset of severe abdominal pain, especially severe above and to the right of the navel. It is increased on inspiration, making the respirations catchy ; by movement, as in attempting to turn over, sit, or flex the right thigh. In 12 out of 14 of Maynard Smith's cases, the initial pain was above the umbilicus, and in 8 of these it was to the right of the middle line. Shock, more or less severe or even fatal (Moynihan), occasionally develops, but it is more frequently slight or absent when the patient is seen by the surgeon ; and then a latent period, as in gastric perforation, may be deceptive and cause delay. Soon tenderness and rigidity come on, especially of the right side and the right flank, and the appendicular region may become immobile and dull, so that appendicitis is diagnosed. Vomiting occurs in about two-thirds of the cases. Later the signs of general suppurative peritonitis develop, with general distension and tympanites. From the first the patient looks gravely ill, and his pulse after the initial shock becomes gradually quicker as a rule.

A previous history of digestive troubles is not so constant as with gastric perforation.

From appendicitis this condition may be distinguished by *a careful study of all the available evidence, the history of a very sudden and severe onset is against appendicitis*, although a latent abscess may occasionally burst and give rise to very sudden symptoms. Most surgeons settle the question at once by opening the abdomen. This is the safest plan for both diseases.

Maynard Smith mentions the interesting case of a man who, whilst cycling, was seized with severe and agonising epigastric pain, and faintness. He was admitted into the hospital in a collapsed condition, with rigidity of the upper half of the right rectus ; a diagnosis of ruptured duodenal ulcer was made, but the operation disclosed " a gangrenous appendix with an abscess which had burst, causing general peritonitis."

The diagnosis is rendered more difficult because the appendix may be placed higher than usual and moreover, appendicitis and perforation of a gastric and duodenal ulcer have been shown to coexist occasionally or follow one another very closely.[2]

[1] Russell, Wallace, and Box (*St. Thomas's Hosp. Reports*, 1897) made some similar observations on the anatomical importance of the " peritoneal watersheds."

[2] Warren Low, Bolton Carter, Lediard and Sedgwick, Watson Cheyne, quoted by Maynard Smith (*loc. supra cit.*), and Graham (*Ann. of Surg.*, 1904, vol. xl, p. 447). Gutch

A mistaken diagnosis of intestinal obstruction has been made, and several cases are mentioned by Lockwood.[1] The rigidity, fixation, tenderness (especially on the right side), and other signs of early peritonitis, and the incompleteness of the constipation may serve to prevent this mistake in most cases. Leucocytosis may also help.

It is almost impossible to tell the difference between a perforation of the duodenum and a similar condition of the pyloric region of the stomach in some cases, for the fluid may pass into the kidney pouch and travel down the right flank exactly as in duodenal ulcer. It must not be forgotten that some acute diseases that may be confounded with gastric perforation may likewise be mistaken for perforating duodenal ulcer (*vide supra*). In one case under my care, the patient had been thought to be suffering from lead colic, and had been treated with purgatives for twenty-four hours before I saw him and found a quantity of castor oil in the abdomen.

Treatment. As for perforating gastric ulcer, an operation should be performed without delay and with as much speed and care as possible. The abdomen should be opened through the upper part of the right rectus muscle, and the fluid mopped by gauze rolls passed into the loins and secured to the towels, and the wound well retracted. Bile-stained fluid often escapes.

The ulcer is most commonly met with on the anterior aspect of the first place, and is thus accessible. Sometimes it is on the posterior surface, as in one of Mr. Lockwood's cases, in which the necropsy showed that it would not have been seen at an abdominal exploration.[2]

The perforation should be closed by means of one or two layers of sutures as in the treatment of perforated gastric ulcer. It is especially important here to pass the sutures in the same direction as the axis of the bowel, to avoid narrowing of the canal when they are tied. An omental graft may be used to fortify the line of suture, and in some cases, where it is not possible to close the perforation, or this involves great narrowing of the lumen, a primary gastro-jejunostomy may be necessary, but it should not be done in other cases unless the condition of the patient is good. In most cases, the patient cannot stand a prolongation of the operation, and it is better to defer gastro-jejunostomy until a later date, and until symptoms indicate the need of it.

Irrigation may or may not be advisable according to the extent of the extravasation, but in most cases it is better not to use it. When it is impossible to close the perforation a cigarette drain extending from it to the surface in front or behind serves to save life, but I have never failed to close the perforation.

Drainage is even more important. Except in early cases slit tubes containing gauze wicks should be passed through the loin into the right kidney pouch, and if the pelvis has been soiled another should be inserted through a suprapubic wound. If the perforation has been sutured and drainage established posteriorly, the anterior incision may be safely closed, and the risk of ventral hernia thus diminished.

(*Lancet*, 1906, vol. i, p. 1243) records the case of a man of 36 who died from hæmorrhage from and perforation of an acute ulcer of the duodenum ; death occurred within two days of an operation for the treatment of appendicitis with abscess formation. A concretion was found in the appendix, but the latter could not be removed.

[1] *Lancet*, 1904, vol. ii, p. 968.

[2] So, too, in a specimen brought by Dr. Pye-Smith before the Pathological Society (*Lancet*, 1893, vol. ii, p. 1443), it is distinctly stated that the ulcer could not have been reached by operation.

Prognosis. Only 7 of Moynihan's collection of 51 cases recovered, and the first was the one operated upon by Mr. Dunn at Guy's Hospital in 1896. Later Moynihan recorded [1] 11 cases with 3 deaths. The shortest interval before operation was four hours, the longest in the acute perforations was three days, and in the subacute three weeks. Primary gastro-enterostomy was performed in 4 cases, and the first of these died. Secondary gastro-enterostomy was necessary in one case, and a sub-phrenic abscess developed in another.

Crisp English [2] found that 2 out of 8 cases recovered at St. George's Hospital in the ten years preceding 1903.

D'Arcy Power [3] records 4 cases, with 3 deaths. In one of these drainage was not used, and an unsuspected collection of pus was found between the liver and stomach.

Mitchell [4] records 28 cases with 25 recoveries. In 7 of these primary gastro-enterostomy was performed, all successfully. In 1910, 58 operations were performed at fourteen London hospitals with a mortality of 39 per cent.[5]

There is little doubt that the prognosis of perforated duodenal ulcer is much more grave than that of gastric ulcer, and this is due chiefly to greater delay in the treatment, owing to the deceptive nature of the symptoms, which may very closely simulate those of appendicitis. The possibility of this grave error is an additional reason for the early or immediate operation for appendicitis. Weir found that of 13 patients with duodenal perforations treated by operation after thirty hours all died, but that of 12 operated upon before the thirtieth hour 66 per cent. recovered.

Perforation of Jejunal and Gastro-jejunal Ulcers. After 1·5 per cent. of gastro-jejunostomies for *non-malignant disease* one or more ulcers may develop either at the anastomosis (gastro-jejunal) or in the jejunum usually just below it (jejunal). About one-third are gastro-jejunal and two-thirds jejunal. The efferent limb of the jejunum is the one most commonly affected. This grave complication is very rare although not unknown after the modern posterior operation with a large anastomosis made between the lower part of the stomach and the jejunum quite near its origin. In the great majority it has followed anterior gastro-jejunostomy, and above all the operation by the EnY method or with entero-anastomosis, in which the acid gastric juice, unmixed with the alkaline bile and pancreatic juice, comes into contact with the mucous membrane of the jejunum. Errors of technique and after-treatment are mainly responsible for it. The acute ulcer perforating the jejunum within about nine days of the operation is partly septic and partly traumatic in origin. The gastro-jejunal often means incomplete healing at the anastomosis. A small opening with gastric stasis seems to be an important factor; excessive trauma and unabsorbable deep sutures are probably others. The uncertain causes of the original ulceration of the stomach or duodenum may still remain. Some of the most likely are chronic septic absorption from a chronic appendicitis or cholecystitis, the ingestion of infective material from a septic mouth, or chronic constipation with errors of habit and diet.

This ulceration is very difficult to cure and is very apt to lead to

[1] *Proceedings of Roy. Soc. of Med. Surg.*, 1910, p. 79.
[2] *Loc. supra cit.*   [3] *Brit. Med. Journ.*, January 10, 1903.
[4] *Brit. Med. Journ.*, October 2, 1909.   [5] Paterson, *Gastric Surgery*, 1913.

perforation at any time from a few days to several years after gastro-jejunostomy.   As a rule this catastrophe is preceded by a normal interval without any digestive symptoms for months or several years.   Then there is a period of indigestion with symptoms simulating those of duodenal ulcer except that the pain, which the patient often describes as burning, is usually situated to the left of the middle line about the level of the umbilicus.   Further, its relation to food is far less striking although it is generally aggravated by solid food, so that the patient limits his diet, loses flesh and becomes anæmic.   Sometimes the pain is relieved by food, but it comes on again in an hour or two.   Usually there are nausea and loss of appetite, and occasionally vomiting and even hæmatemesis with signs of dilatation of the stomach.   There are often tenderness and resistance to the left of the umbilicus, and there may be an induration here due to plastic peritonitis with adhesion to the parieties, and even a cutaneous fistula may form.   At any time signs of perforative peritonitis may develop.   In another class of case there is no period of indigestion, but the patient, who appears to be in perfect health, is suddenly seized with violent abdominal pain and all the signs of spreading peritonitis soon develop.

Operation.   In the main this is the same as that already described for perforated gastric ulcer, but as the patient is usually in a worse condition even more speed, skill and judgment are required to ensure success.   The old scar is avoided on account of adhesions and, moreover, a wound lower down and to the left of the middle line gives more direct access.   The middle third of the left rectus is split or displaced outwards.   Yellowish sero-pus and gas escape.   Gauze rolls are passed into the loins and pelvis and secured to the towels.   These absorb the effusion while the perforation is sought and closed.   When the gastro-jejunostomy is anterior the limbs of the jejunal loop are at once seen running almost vertically downwards from the stomach, and a perforation is seen either at or just below the anastomosis ; sometimes it is near the entero-anastomosis. It is closed with a catgut stitch reinforced with linen thread.   When the gastro-jejunostomy is posterior and therefore usually of the Y-shaped type, the omentum and transverse colon may be so adherent as to be difficult to bring forwards and upwards out of the way.   The adhesions are separated by gauze dissection and all bleeding vessels tied.   The condition of the patient rarely allows a radical operation at this stage, but the size of the anastomotic opening and pylorus should be ascertained so that some forecast of the future may be made.   Sometimes there may be time to enlarge the gastro-jejunostomy opening after Finney's method of enlarging the pylorus.   The peritoneal cavity is cleansed by gauze rolls as already mentioned, but if the extravasation be extensive, lavage may be chosen.   The wound is completely closed, but in most cases drainage is established through a stab wound above the pubis.   Through this a split rubber tube, containing a wick of gauze, is passed towards the pelvis.

Every attempt is made to cure the ulcer by careful medical treatment.   This consists essentially of prolonged rest in bed on bland albuminous and fatty foods with alkalies to neutralise the over-acid gastric juice.   If this fail a radical operation must be undertaken when the condition of the patient allows.

The following interesting case illustrates some of the difficulties that may be met.

Anterior Gastro-jejunostomy; Perforated Jejunal Ulcer; Suture and Drainage. Later detachment of Jejunum; Excision of Ulcer; Gastro-duodenostomy. Recovery.

E. R., male, aged 30. June 1905: Anterior gastro-enterostomy, elsewhere, for pyloric obstruction. Complete relief for four and a half years. Then pain in abdomen to left of navel, partly relieved by food. In April 1910 sudden, very severe pain between shoulders, as if a knife had been stuck in. Could not stand up
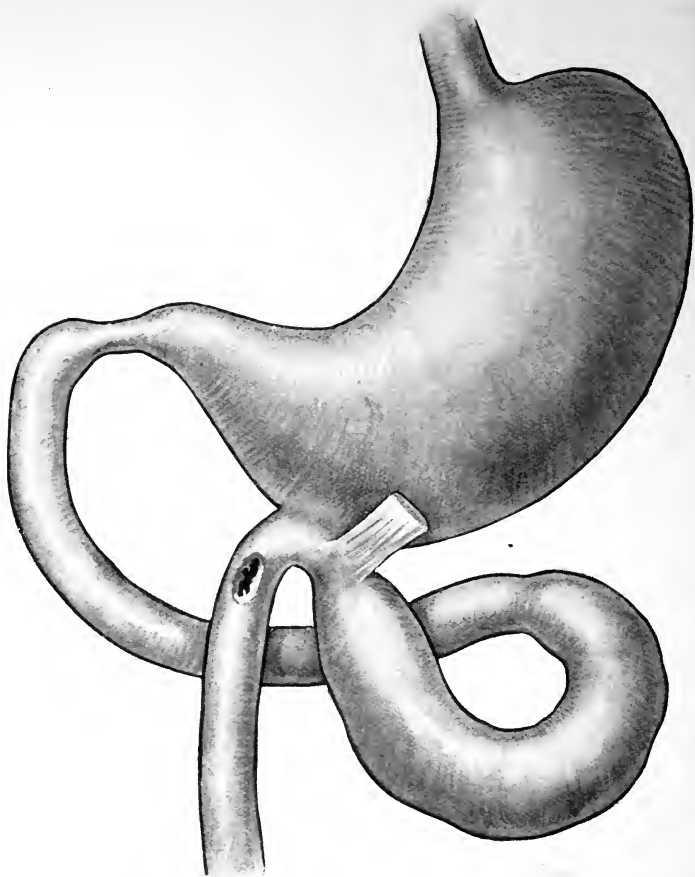

FIG. 81. Perforated jejunal ulcer. The gastro-jejunostomy was anterior and the jejunal loop had dilated, the stoma had almost closed.

straight. "Got home with great difficulty and was in bed for two days. Since then a heavy sort of pain like a stone on the left side towards navel." Later pain got more severe but was relieved by food for a time. Appetite fair. Bowels very free. Wasted. For three weeks before perforation pain unusually severe.

On September 2, 1910, at 6.30 P.M., during micturition, suddenly felt a terrible burning and sharp aching pain running downwards from navel to pubes. Pain not relieved by morphia. Patient admitted to Guy's Hospital seven hours after perforation, and abdomen opened half an hour later. Large amount of sero-purulent, sanious fluid and gas escaped. The pelvis, both flanks, and the sub-diaphragmatic space on both sides were full of this sero-purulent liquid. Anterior gastrojejunostomy without entero-anastomosis found; proximal limb of jejunum greatly dilated and hypertrophied. Dense adhesion between its gastric end and parieties, indicating an old perforation, in April. Large perforation in distal limb 1 in. below

gastro-jejunal opening (*see* Fig. 81). The latter only ¾ of an inch in diameter. Perforation closed, abdomen washed out, and tube inserted at lower angle of wound. Patient did well while in hospital, but soon afterwards symptoms returned in spite of continued medical treatment. Readmitted once for prolonged medical treatment. Improved a great deal, but had not been out many days before old pain and vomiting returned. Burning pain and feeling of bursting.

Operation, May 1911 : Jejunal ulcer now adherent to the liver, detached, and thus opened. Pylorus almost occluded and adherent high up and far back. Jejunum then detached from stomach. Ulceration around stoma and jejunal ulcer excised. Large jejunal wound closed transversely without narrowing of lumen. Gastric wound enlarged up and to the right for 3 in., and joined to similar opening made in front of first and second part of mobilised duodenum. Symptoms have abated. Patient has gained weight, and I saw him quite well 3 years later.

Radical operations for these conditions will be discussed with the complications of gastro-jejunostomy.

CHAPTER XI

GASTRO-JEJUNOSTOMY [1]

In this operation a direct communication is made between the stomach and the jejunum. The anastomosis may be either anterior or posterior as regards the stomach and transverse colon. Although the operation is a very valuable one in suitable cases, it should only be performed after careful consideration. The immediate risk is now so slight that it may be performed without adequate reason ; therefore it is most important to consider the indications for and against the operation. It should never be performed except for demonstrable organic disease or obstruction of the stomach or duodenum, for apart from these the operation is not only useless but it may be very harmful in its ultimate results.

It is necessary to refuse the operation in late cases of growth, and particularly in all cases of gastric neurosis, gastroptosis or chronic dilatation. To perform gastro-jejunostomy for the crises of locomotor ataxy or the vomiting of early phthisis can only be due to gross carelessness in diagnosis. These and similar mistakes show that this valuable operation is in some danger of being abused.

On the other hand the operation is too long deferred in many suitable cases. Both the immediate and the ultimate results are much better if the operation is performed at the right time, and years of misery may be prevented by more careful examination of the stomach, especially with the bismuth and X-ray method. In other cases a timely exploration will at once prove that a gastro-jejunostomy is strongly indicated. When exploration of the abdomen fails to reveal an adequate cause for the operation, it should not be performed, but some other cause of the symptoms must be sought, especially disease of the appendix or gall-bladder. A general and careful exploration must be made.

Indications. (A) **In selected cases of gastric and duodenal ulceration.**

(i) In most cases of pyloric or duodenal stenosis due to contraction of a healed ulcer, but in some of these cases without much dilatation, especially in women, gastro-duodenostomy is to be preferred. Delay in emptying and dilatation of the stomach are shown by the vomiting of large quantities of characteristic material, by examination of the gastric contents withdrawn by means of the stomach tube at various intervals after a test meal, and especially by X-ray examination. The operation should be undertaken long before there is great dilatation of the stomach, much wasting or such late symptoms as gastric tetany. In slight cases as shown by Maylard the symptoms of obstruction are intermittent, an attack being brought on by overwork, mental fatigue, or indiscretion in

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[1] To be accurate, the term gastro-jejunostomy should be used for union of jejunum to stomach, gastro-duodenostomy for union of duodenum and stomach. The term gastro-enterostomy, which has been carelessly used for either of the above operations, should be dropped.

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diet, and abating as soon as the patient rests under medical treatment. Gastric tetany is nearly always due to pyloric stenosis, and then calls for immediate gastro-jejunostomy, for delay may be fatal. I remember a patient dying in a spasm during the night before the day fixed for her operation. The prognosis after operation is not nearly so grave as used to be thought and Moynihan reports fourteen operations for it without a single death. The anæsthetic stops the spasms, but a few may occur after the operation.

(ii) In all cases of chronic or relapsing ulcer of the duodenum, pylorus or prepyloric region (within three inches of the pylorus), whose symptoms have not been abolished by complete rest from work for three months with careful dieting and medicinal treatment, or where symptoms recur after such treatment. An ulcer within about two to three inches of the pylorus causes spasm of the latter and rarely heals until a short circuit is made. In certain cases the operation has to be undertaken earlier, for adequate medical treatment may not be practicable on account of poverty or intolerance, or the patient may not do well under it, but wastes, bleeds or develops signs of dilatation.

(iii) For recurrent hæmorrhage from chronic gastric or duodenal ulcers. Gastro-jejunostomy is the speediest, simplest and most efficient way of preventing hæmorrhage in these grave cases. In most cases infolding of the ulcer should also be done. It is rarely, if ever, wise to operate during severe hæmorrhage.

(iv) In a few cases of perforating ulcers in the same area, or at the neck of an hour-glass stomach, where suturing narrows the passage to a serious extent, or, from the size of the ulcer, healing may be expected to do the same ; but Ellsworth Elliot and MacCallum [1] experimenting on cats and dogs respectively, found it difficult to produce permanent narrowing of the duodenum by excising fairly large portions of its wall and suturing the large perforations thus made. Primary gastro-jejunostomy can rarely be borne, and even secondary gastro-enterostomy is rarely necessary.

(v) In certain cases of chronic ulceration of other parts of the stomach, when symptoms persist in spite of careful medical treatment, and where excision is impracticable without grave risk on account of the extent, position or adhesion of the ulcer, which may be invading the pancreas or liver. The excision of such an ulcer may be a very formidable and dangerous operation, so that gastro-jejunostomy is easier and safer, although it may not seem so good. I have found it very efficient in immediately relieving the severe pain commonly associated with ulcers high up on the lesser curvature. It also undoubtedly promotes healing. Once I had to open the abdomen a year later for intestinal obstruction and I found only a small scar where there had been a large ulcer on the lesser curvature. In one patient, however, although the pain ceased at once and the patient gained weight and improved almost out of recognition, severe hæmorrhage suddenly came on six months later and recurred. I then removed the ulcer, which is in the Museum at Guy's Hospital and shows a bristle in the perforated gastric artery. The patient made a good recovery and has remained well for three years. The gastro-jejunostomy opening was a large one and had not narrowed by the time of the second operation. In some cases excision of the ulcer is combined with gastro-jejunostomy, for excision avoids the danger of present

[1] *Ann. of Surg.*, 1912, vol. i, p. 563.

or future malignant change in the ulcer, and the gastro-jejunostomy aids the healing of the large wound in the stomach and may prevent the recurrence of ulceration.   It is not easy to explain the undoubted benefit conferred by gastro-jejunostomy for ulceration so far removed from the pylorus.   On examining these patients with the X-rays before the operation, peristalsis is seen to be abnormally active and associated with pain. This diminishes greatly after gastro-jejunostomy with a large opening. Moreover the ulcer is not likely to be stretched or long irritated by food after the operation.   Above all the over-acid gastric juice is neutralised by the free passage of bile and pancreatic juice through the stoma into the stomach.   The magic relief of pain enables the patient to eat freely again and thus to improve his nutrition.

(vi) For certain cases of hour-glass contraction of the stomach in which the pyloric pouch is small and the pylorus is not contracted.   An anastomosis between the large cardiac pouch and the jejunum is then the best and simplest treatment.   This subject will be discussed more fully later.

B. **For certain cases of irremovable pyloric or duodenal obstruction** from (1) adhesions outside, such as may occasionally follow perforation of a gastric or duodenal ulcer or disease of the gall-bladder, or may be due to (2) the pressure of a new growth of the gall-bladder, pancreas or right kidney.

C. **For stenosis of the pylorus or pyloric segment of the stomach due to corrosive poisoning.**   Sometimes a gastrostomy is also required at the same time.   In one of my cases the pyloric obstruction was naturally overshadowed by the œsophageal obstruction, and was only discovered after the abdomen had been opened.   Both operations were rapidly performed and the patient made a good recovery.   The gastrostomy was only required for a few weeks.   The following case shows the amount of damage that may be done to the stomach by a corrosive, without permanent injury of the œsophagus or perforation of the stomach.[1]

A man, æt. 41, in a fit of depression swallowed about six ounces of spirits of salts [2] on April 13, 1910, and suffered severely from shock, and later from dysphagia, hæmatemesis, and vomiting.   On May 13, 1910, he vomited a cast of the pyloric half of his stomach.   This consisted of the whole thickness of the mucous membrane with some of the sub-mucous tissue and muscular coat.   The vomiting increased and the patient wasted rapidly.   The cardiac remainder of the stomach dilated, but the pyloric portion was practically obliterated, as shown by Dr. Hertz upon examination with the bismuth and X-ray method.   I operated on June 13.   The abdomen was opened through the upper part of the left rectus.   The cardiac part of the stomach was so distended that it was difficult to get a view of the pyloric part and of the duodenum, and it was found impossible to bring the posterior wall of the stomach down through the rent made in the transverse mesocolon, although the patient had not had any food by the mouth for nine hours.   A stomach tube was passed, and two and a half pints of coffee-coloured liquid and debris, but no gas, escaped.   It was now quite easy to examine the stomach thoroughly.   The pyloric part was hard and narrower than the first part of the duodenum, which was quite normal.   It looked like a narrow and thick-walled piece of small intestine ; it was fixed to the posterior wall of the abdomen.   The narrowing was most marked five inches from the pylorus, immediately to the right of the distended cardiac pouch.   From this point a tough thick band extended to the under surface of the right lobe of the liver.   The gastro-colic omentum had been drawn up at the same spot, and was adherent to the front wall of the stomach and to the lesser omentum. Otherwise the anterior wall of the stomach was free from adhesions.   There were many enlarged and very hard glands in the lesser omentum and about the head of the pancreas.   Several recent adhesions were present on the under surface of the transverse mesocolon towards the right, and the mesocolon was generally shrunken,

[1] Clarke, Hertz and Rowlands, *Guy's Hospital Reports*, vol. lxiv, p. 295.
[2] Spirits of salts are about the same strength as acidum hydrochloricum.

so that it was rather difficult to make a free opening within the loop of blood-vessels. Owing to the adhesions between the pyloric part of the stomach and the posterior wall of the lesser sac, it was difficult to bring any of the cardiac pouch down through the mesenteric aperture. With the aid of clamps posterior gastro-jejunostomy was performed after Mayo's method. The mucous membrane of the stomach was inflamed, thin, and very friable. The sero-muscular coats of the stomach were also thinner, and far more friable than natural, so that the sero-muscular suture tore out at several places. The patient bore the operation well and made a rapid and complete recovery. His mental depression also soon disappeared. He was quite well in every way three and a half years after the operation.

D. **Congenital hypertrophic stenosis of the pylorus.** In a few cases of this condition for which an operation has to be performed, gastro-jejunostomy is probably the best, although good results have also been obtained from pyloroplasty.

E. **It may be made use of for malignant disease of the stomach or duodenum under the following conditions :** (i) *Together with partial gastrectomy.* This is always to be preferred to an end to end union because it allows the more free removal of the growth, shortens the operation and makes it easier. A very thorough examination of the liver, pancreas and peritoneum should precede the resection. When the patient is feeble the gastro-jejunostomy should be done first so that the resection may be deferred until another time if the patient is not standing the operation well. (ii) *As a preliminary to partial gastrectomy, which should be performed two or three weeks later.* This is more valuable in feeble patients for it enables them to eat freely and improve their nutrition sufficiently to bear the second operation. But this plan has the objection that the patient's condition may be so much improved that he refuses the radical operation.

(iii) *Alone.* This is clearly a very inferior operation to those of gastro-jejunostomy with either primary or secondary resection. If all the cases of gastro-jejunostomy which have been performed for growth had been published, it is certain that the results both as regards the immediate mortality and the duration of life would be most disappointing. This is partly due to the fact that the operation has been far too often performed in very emaciated patients quite unfit to bear the operation and to supply the necessary plastic repair. For the future simple gastro-jejunostomy should be reserved for the following cases : (i) When the growth causes obstruction and is irremovable, that is, when a growth extends too far along the lesser curvature of the stomach, or when it is too fixed to the liver or pancreas to make a partial gastrectomy justifiable, or secondary deposits and fixed enlarged glands can be felt. Gastro-jejunostomy is worse than useless when the growth does not cause obstruction. (ii) Where the cachexia and emaciation [1] of the patients are not so marked that it is very doubtful whether they will survive an operation that necessitates the handling of very vital parts, and for its success entails a certain adequate amount of plastic repair. The risks of pulmonary and other complications in these late cases must also be remembered.

These marasmic patients also suffer much more severely from shock than those with non-malignant disease, even when the operation is very quickly performed.

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[1] In 12 out of 98 cases collected by Dr. Ticehurst (*loc. infra cit.*) the patients had lost more than a stone a month, and 7 of these died from the operation ; and out of 23 others, in which the wasting was very considerable, 10 died.

If the operation be reserved for the above cases it will be called for less frequently than of late years, but will be found in these to give great relief and to prolong life for some months. If surgeons continue to perform it, as gastrostomy has been too often performed for malignant disease of the œsophagus, in cases where the operation comes too late, their patients, if they survive, will do so for a very short time, succumbing to the effects of a marasmus so established as to be unalterable.

In recent years improvements in the technique of the operation have greatly reduced its mortality even in malignant disease.

Dr. W. J. Mayo [1] states that he and his brother, Dr. C. H. Mayo, had performed in all 114 gastro-jejunostomies for malignant disease with 21 deaths, a mortality of 18 per cent. Of these 114 cases 63 were in connection with pylorectomy or partial gastrectomy, with 8 deaths (13 per cent.). The very unfavourable cases of cancer obstruction were subjected to gastro-enterostomy, so that this operation gives a higher mortality than radical excision. In the last 40 gastro-jejunostomies for malignant disease the mortality was 8 per cent.

Sir Berkeley Moynihan [2] had performed gastro-jejunostomy for malignant disease 35 times between 1897 and July 1905, with 5 deaths, or a little over 14 per cent. The first 7 operations were anterior, and the Murphy button was used, with 2 deaths. The last 28 were posterior suture operations, with only 3 deaths.

It is to be hoped that with earlier exploration and diagnosis gastro-jejunostomy will be replaced to a greater extent by resection, although many patients will always present themselves so late that only a palliative gastro-jejunostomy can be performed. At present many come too late for any operation.

GASTRO-JEJUNOSTOMY. GENERAL CONSIDERATIONS.

Before describing some of the chief methods of performing the operation of gastro-jejunostomy, it is important to draw attention to certain points which are essential to all of them.

(1) **The opening must be a large one, at least three inches long,** for a small stoma does not drain the stomach well, and a short attachment of the engaged viscera is more likely to lead to kinking. A small opening may contract or even close as a result of gastro-jejunal ulceration. This was not uncommon after the use of the Murphy button, especially when there was no permanent narrowing of the pylorus. A very large opening is probably harmful in that it allows the stomach to empty too rapidly (Hertz).

(2) **The orifice must be placed at the lowest part of the stomach as the patient stands,** for most of the food has to pass through the orifice during the day. There is much evidence to show that vomiting and recurrence of symptoms are largely due to malposition of the orifice, but the position of the opening into the jejunum is of even greater importance. It must be quite close to the duodeno-jejunal flexure.

(3) **Some of the mucous membranes of the stomach and jejunum should be removed** in order to prevent valve formation. An elliptical opening is thus made instead of a mere slit (Moynihan and Littlewood [3]).

[1] *Ann. of Surg.*, 1905, vol. xlii, p. 642.
[2] *Clin. Soc. Trans.*, 1901, vol. xxxix, p. 84.
[3] *Loc. infra cit.*

When the Murphy button was used, this plan was not necessary, for the button induced sufficient sloughing, but the size of the aperture made by a button which must be small enough to travel through the ileum is too small for satisfactory permanent drainage of the stomach. Moreover, it heals by granulation, and is therefore unusually liable to cause gastro-jejunal ulceration with contraction of the opening.

(4) **The use of Clamp Forceps.** Long clamp forceps are invaluable for this operation, for they arrest hæmorrhage, prevent any leakage, and steady the parts during the operation; they also greatly facilitate the suturing. Littlewood [1] and Moynihan [2] were amongst the first to use and recommend them in this country, and Moynihan's writings have done much to popularise them here and in America. Now their value is almost universally recognised, although some surgeons never use them because
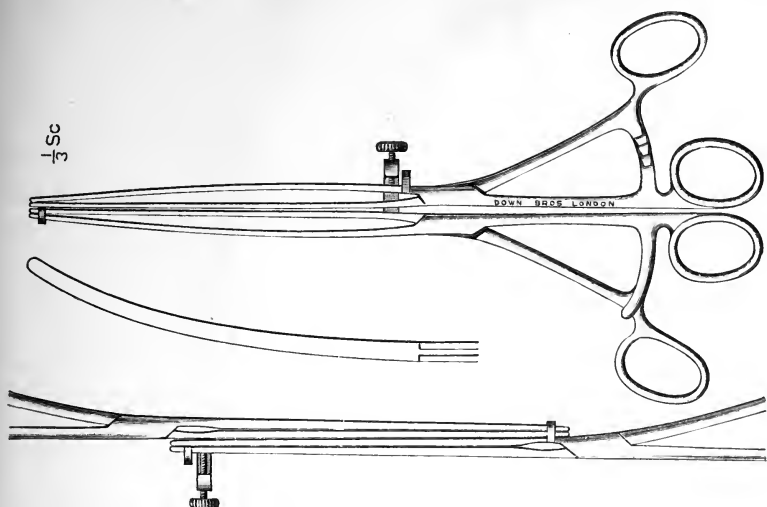
Fɪɢ. 82.   Lane's Clamps (Down Bros.).

they are afraid of hæmorrhage after their use (*see* Fig. 82). There is little fear of this, however, if the sewing is carefully done and suitably elastic clamps are used so that the mucous membrane is not damaged by them.

(5) **Sutures.** It is best to use a continuous catgut [3] suture which pierces all the coats, and to reinforce this by a continuous sero-muscular suture of fine linen or Pagenstecher's thread. It is essential for the deep suture to pierce all the coats, so that it may not bite out before firm union has occurred, and lead to disastrous leakage. A continuous suture is far more quickly applied than interrupted sutures, and a continuous piercing suture controls hæmorrhage better than any other, and for this purpose the turns should not be more than one-eighth of an inch apart. Halsted's suture, although it is the most secure of the sero-muscular stitches, does not control hæmorrhage well, and several deaths from

[1] Mr. H. Littlewood on "Intestinal Suture by Means of Continuous Catgut Stitch and Excision of the Mucous Membrane" (*Lancet*, 1901, vol. i, p. 1817); a paper read before the Leeds and West Riding Medico-Chirurgical Society on October 19, 1900. The paper is illustrated, showing the use of Doyen's clamps for gastro-jejunostomy.
[2] Mr. Moynihan, *Brit. Med. Journ.*, Dec. 9, 1900, p. 1631.
[3] W. J. Mayo believes unabsorbable deep sutures delay healing and promote ulceration. He has seen silk hanging from an ulcer at the anastomosis eighteen months after gastro-jejunostomy.

bleeding have followed its use. Moreover, it is not so secure as a piercing suture, and as it does not bring the mucous edges together properly, it is very apt to be followed by the formation of valvular folds of mucous membrane, which may obstruct the orifice unless this is very large. The deep suture may be either a circular (overstitch) or a mattress one; the latter secures better inversion towards the end, but is more likely to cause puckering unless properly applied. The knots should be upon the mucous surface.

The continuous Lembert or Cushing suture should be used to reinforce the deep one, and to secure wide serous apposition and union. The suture should turn in a little more of the serous surface of the stomach
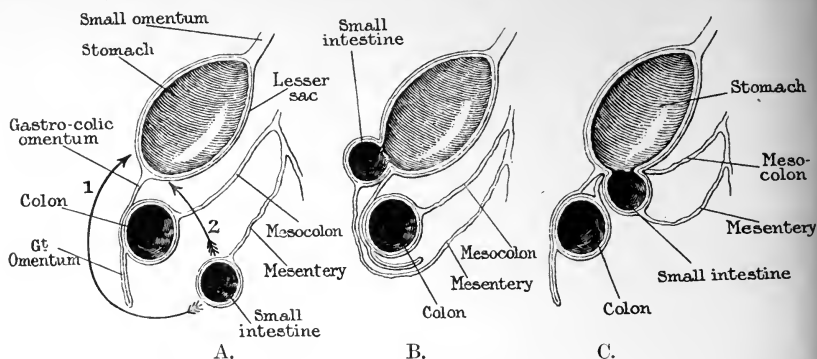
Fig. 83. Gastro-jejunostomy shown diagrammatically. A, The parts are here shown in their normal relations and attitudes. The arrow 1 shows the anterior operation after the method of Wölfler, that marked 2 the method of Von Hacker. B, anterior gastro-jejunostomy. C, posterior gastro-jejunostomy. It will be noticed that this provides the most dependent opening both in the upright and prone positions.

than of the jejunum, so that the lumen of the latter may not be unduly narrowed or flattened.

(6) **The use of Packs.** It is essential to carefully pack behind and around the pouches engaged in the operation to prevent contamination of the peritoneum or parietal wound.

Different Methods. (1) *Posterior gastro-jejunostomy without a jejunal loop*; (2) *anterior gastro-jejunostomy*; (3) *Roux's Y method*; (4) *anterior or posterior loop operations with entero-anastomosis.*

The Choice of Operation. It is now generally believed that the posterior no-loop operation is the best, but the reasons for this belief should be mentioned here.

(*a*) *Anatomical and physiological considerations.* If drainage of the stomach depends to any great extent upon gravity, it is clearly better to make the opening low down upon the posterior inferior surface than anywhere upon the antero-superior surface. This is true even when the body is upright, and the advantage is greatly increased when the patient is recumbent (*see* Fig. 83). But the weight of the long limbs of the jejunal loop used for the anterior operation certainly drags the anterior opening downwards to some extent. It must be remembered also that the stomach is not a passive bag, and that its drainage is not entirely dependent upon gravity. The larger the stoma, however, and the more damaged the muscular power of the stomach, the greater the advantage of securing a dependent opening. The results of the ingenious experi-

ments of Cannon and Blake upon the healthy stomachs of animals are not strictly applicable to the diseased conditions which call for gastro-jejunostomy in man. Physiologically it is an advantage to make an opening high up in the jejunum, so that as little as possible of the small intestine may be lost for the purpose of digestion and absorption; but the researches of Paterson tend to show that absorption is hardly, if at all, diminished even by anterior gastro-jejunostomy, in which the opening into the jejunum is lowest. It is of more importance to prevent the acid chyme reaching the jejunum too low down. Therefore, upon anatomical and physiological grounds, the posterior operation without a loop is better than any anterior operation, and it is certain that the posterior no-loop operation is superior to all others because it interferes less with the normal anatomical and physiological conditions and relations. If any one should still prefer to use a Murphy button the posterior operation is the best one to choose, for the button fell into the stomach and was retained in at least a third of the anterior operations, whereas it passed on into the intestines after nine-tenths of the posterior operations. I know of a patient who required a second gastro-jejunostomy fifteen years after the use of a button. The button was not found at the second operation, but some weeks later it passed through the large new opening, turned sideways and obstructed the ileum, whence it was removed. The patient recovered.

(b) *The anterior operation may be a little easier* than the posterior no-loop operation, especially if performed by surgeons of little experience and skill, but the difference is very small, and the time saved is trivial.

A short or diseased mesocolon may occasionally make a posterior gastro-jejunostomy difficult or even impossible, and adhesions of the posterior wall of the stomach may very rarely do the same, but it is exceptional for growth or simple ulceration to affect the part of the stomach which is incised for posterior gastro-jejunostomy. When this part is affected, it is generally too late for the operation to be performed at all. A bulky great omentum may occasionally prolong and increase the difficulties of anterior gastro-jejunostomy.

It has been stated that the jejunum may unduly fix the stomach in no-loop operations, but there is no real evidence of the validity of this objection. Too much tension must be avoided. In one case in which the jejunum originated to the right of the spine Munford[1] performed the no-loop operation, with the result that the excessive tension led to separation and leakage at the suture line.

(c) *Regurgitant vomiting* is far more common after the anterior operation on account of the loop of jejunum between the duodeno-jejunal flexure and the anastomosis. The posterior operation should avoid the loop altogether and vomiting after it is rarer than after any other method except that of Roux, which is too severe and prolonged for general adoption.

(d) *Intestinal obstruction.* This has been a little more frequent after the posterior operation. Moynihan[2] mentions three cases in which the small intestine herniated into the lesser sac through the rent in the mesocolon. This accident should not occur again, for it can be prevented by sewing the edges of the rent to the jejunum or stomach. This orifice has also contracted upon the jejunum or upon the anastomosis, but this rare event is probably preventable by careful suturing, as above indicated.

[1] *Ann. of Surg.*, 1906, vol. xliii, p. 88. [2] *Lancet*, 1906, vol. i, p. 1345.

After the anterior operation the jejunal loop has compressed the colon, or *vice versa*, and in one case both the jejunum and the colon were obstructed by mutual compression, although the anastomosis was made twenty-four inches below the duodeno-jejunal flexure. The obstruction was so complete, that the intestine between the jejunal loop and the middle of the transverse colon was collapsed and almost empty. In one case quoted by Mayo the small intestine passed over the afferent jejunum, and became strangulated. Intestinal obstruction is very unlikely after the no-loop operations.

(*e*) *Perforating Jejunal Ulcer.* This has been more frequent after the anterior operation, and after adding entero-anastomosis to any form of gastro-jejunostomy.

(*f*) *Posterior operations* allow a more thorough examination of the posterior wall of the stomach.

It may be concluded that the evidence is strongly in favour of posterior no-loop operations. Therefore these operations are described first, and the procedures least recommended are described last.

Posterior Gastro-jejunostomy (Von Hacker) has been very considerably modified in recent years. Czerny performed the operation without a loop years ago, generally with the aid of the button and supplementary sutures, with great success. Mikulicz used a transverse jejunal incision in performing the no-loop operation. The advantages of avoiding a loop have become widely known from the writings of Petersen, and the operation has been greatly facilitated by the aid of clamp forceps. Mikulicz's method of making a transverse incision in the jejunum does not allow a large opening to be made, for it must be smaller than half the circumference of the bowel, otherwise it may lead to obstructive symptoms from kinking and valve formation. This happened in four out of forty-three of these operations recorded by Dr. W. J. Mayo, and four secondary operations had to be performed. The opening from the stomach into the distal part of the intestine was successfully enlarged by performing Finney's operation (*see* p. 178) on either side of the opening. It was said to be impossible to make an entero-anastomosis on account of the shortness of the available intestine above the gastro-jejunostomy, but mobilisation of the terminal part of the duodenum usually makes this possible.

(1) POSTERIOR GASTRO-JEJUNOSTOMY WITHOUT A JEJUNAL LOOP.

A vertical incision five inches long is made three-quarters of an inch to the right of the middle line, over the upper part of the right rectus abdominis, and extending down to the level of the umbilicus. The rectus sheath is opened and the muscle fibres split or displaced outwards. It is easier to sew the deep layers after the fibres have been split. The abdomen is then opened by incising the posterior layer of the fibrous sheath and the peritoneum in a line with the original incision. This opening is much shorter than the incision through the superficial parts so that it may be easier to close it later on. The stomach, duodenum, gall-bladder and appendix are thoroughly examined and inspected as far as possible before deciding which operation, if any, to perform. It often happens that gastro-enterostomy proves to be unnecessary, and other operations necessary, such as removal of the appendix or gall-stones, or one of these may be required in addition to gastro-enterostomy. I

remove the appendix always if time permits, for it is almost invariably diseased in these cases. In women the pelvis should also be examined for fibroids or ovarian cysts. The great omentum and the transverse colon are drawn well forwards, upwards and to the right, making the meso-colon
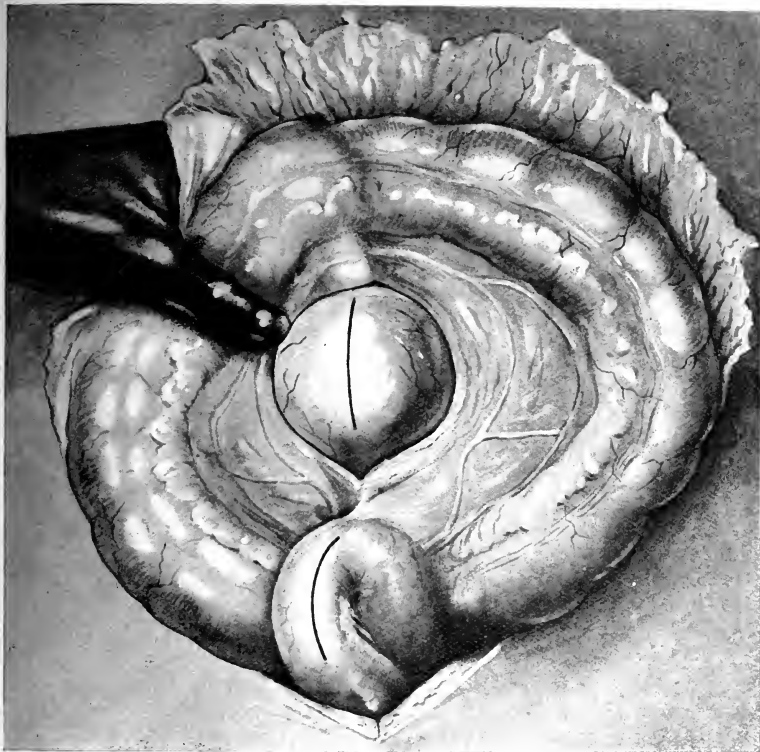
FIG. 84. Posterior gastro-jejunostomy. The opening in the transverse meso-colon is shown and the sites of the incisions to be made in the stomach and jejunum. The suspensory ligament at the duodeno-jejunal flexure is shown just above the jejunal incision.

taut and bringing it well into view (see Fig. 84). A bloodless part of it close to the ligament of Treitz is selected, picked up with forceps, drawn downwards and away from the stomach and snipped with scissors. The ligament of Treitz extends from the mesocolon to the duodeno-jejunal flexure. The opening thus made in the lesser sac is carefully enlarged until it admits three fingers, and through it the posterior surface of the stomach is thoroughly examined. The lowest part of the greater curvature is selected for the site of the anastomosis. When the proper site has been noted the left hand in front is used to push the posterior wall of the stomach downwards through the opening in the mesocolon so that the right hand may grasp and pull it downwards and forwards sufficiently for the easy application of the clamp on a slightly oblique and emptied fold, at least four inches long, running downwards slightly to the left near the lower border of the stomach (see Fig. 85). The points of the blades are below the greater curvature. The handles of the clamp are then

brought upwards to the right and held by an assistant. By drawing the transverse colon forwards and to the right and passing the finger backwards and to the left along the under surface of the mesocolon, the duodeno-jejunal flexure and the ligament of Treitz are easily found. The
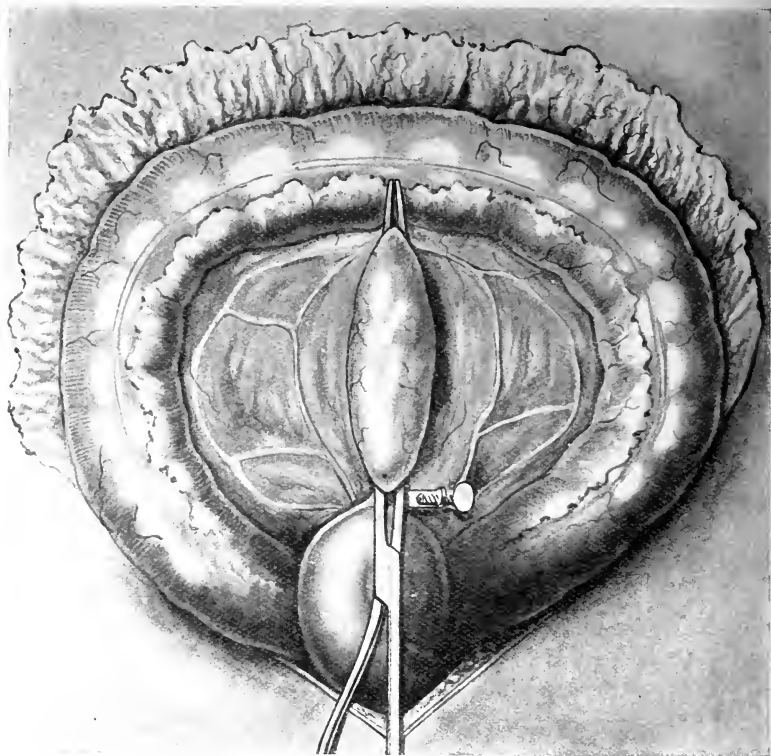
Fig. 85. Posterior gastro-jejunostomy. The clamp is applied to the stomach so that its point is below the greater curvature. The handles should be directed more to the right of the patient.

jejunum near its origin is brought into the wound. A fold of it four inches long, including the free border, is emptied and clamped, the tip of the blades being about one inch from the duodeno-jejunal flexure [1] (see Fig. 86). The protruding portions of the omentum, colon and excess of jejunum are returned into the abdomen to avoid undue exposure and distension. A long strip of gauze moistened with hot saline solution is now placed between the two clamps, which are afterwards closely approximated and locked in position so that the assistant may be free to assist in other ways (see Fig. 87). Large warm moist pads are now arranged around and under the clamps so as to isolate the clamped pouches and protect the wound from infection (see Fig. 88).

A continuous sero-muscular suture of thin linen thread or silk is

[1] Dr. W. J. Mayo prefers to place the forceps with their handles to the right, because tis easier to apply them, but it is an advantage for the handles to be held by an assistant who faces the operator. If a Roosevelt clamp is used, it is most conveniently applied with the points of the blade towards the patient's head.

now used to join the adjacent edges of the two viscera for a distance of at least three and a half inches. It is begun on the left, where the tail of the knot is held with forceps. The thread should be always held taut, to secure close approximation and to raise a fold of sero-muscular
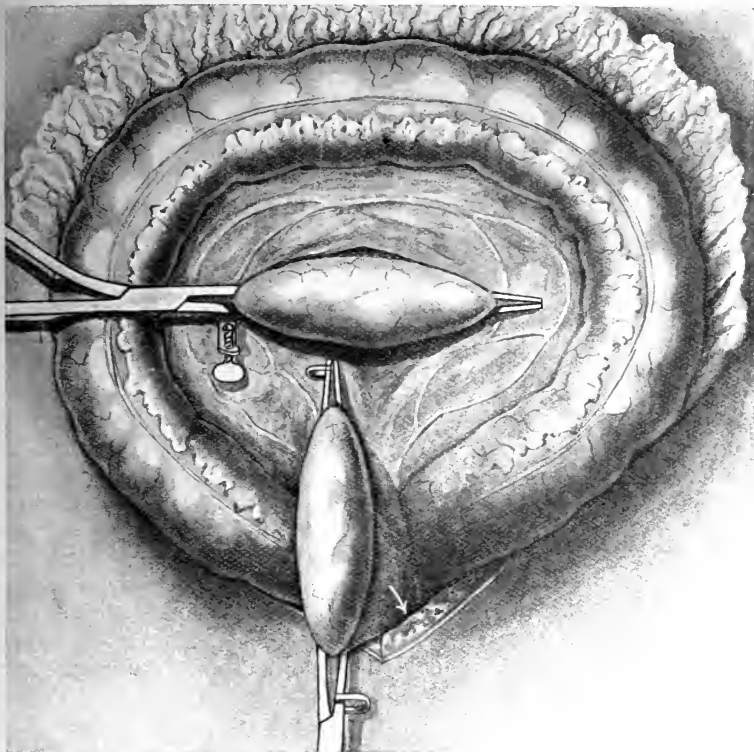
Fig. 86. Posterior gastro-jejunostomy. The gastric clamp is rotated so that its end points to the left. The jejunal clamp has been applied with its point close to the duodeno-jejunal flexure.

tissue after each stitch, for this simplifies the introduction of the next one (see Fig. 89).

When the first half of this superficial suture has been inserted, the serous and muscular coats of the stomach and jejunum are incised, so as to expose and liberate the mucous membranes which pout into the wounds. An elliptical piece of mucosa, about two and a half inches long and over half an inch wide, is excised with scissors in one piece from the stomach. A similar piece is removed from the jejunum, but this is not so easy and often has to be done piecemeal (see Fig. 90). The incision thus made should be a quarter of an inch in front of and parallel to the posterior sero-muscular suture-line. The assistant mops up any escaping contents of the pouches and carefully dries each pouch. The contaminated mops are thrown away at once.

The gastric mucous membrane is prevented from retracting by means of tissue forceps, if necessary.

Reliable and strong catgut [1] should be used for the deep suture, which

[1] Van Horn No. 2 tanned catgut, lasting about twenty days, does well.
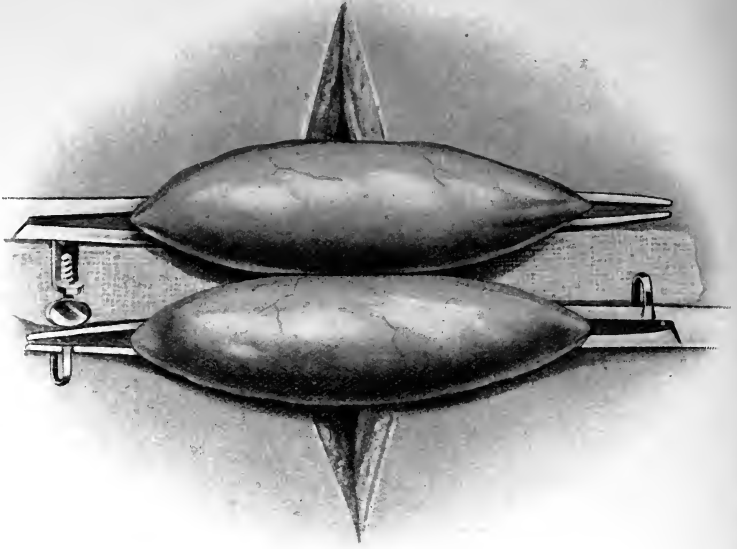
Fig. 87. Posterior gastro-jejunostomy. A strip of moist gauze is placed behind and between the clamps, which are brought together with their points in opposite directions.

pierces all the coats. It should be commenced at the left extremity of the anastomosis. The knot is placed upon the mucous surface, and the tail thread is held with forceps (*see* Fig. 91). Tissue forceps applied at the right ends of the wounds hold the jejunum and stomach together

Fig. 88. Posterior gastro-jejunostomy. The clamps are locked and the pouches of stomach and jejunum are completely packed off.
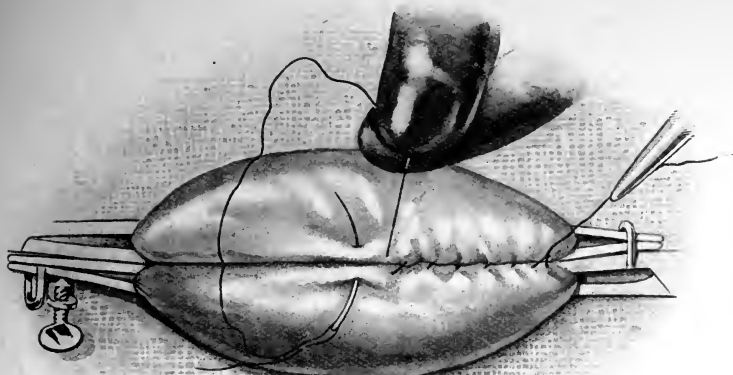
FIG. 89. Posterior gastro-jejunostomy. The first or sero-muscular suture is started on the left, and continued to the right extremities of the pouches.

and well up, and make the sewing easier. The suture is continued as a circular or overstitch as long as inversion of the edges can be easily made (see Figs. 92 and 93). As soon as any difficulty arises at the right extremity, the needle is passed after the method of Connell with " the loop on the mucosa " (see Fig. 94). This is an excellent and rapid way of completing the suture and it inverts the edges, bringing the serous surfaces into contact. Tissue forceps are applied near the left end of the anastomosis to hold the anterior lips of the wound together. Both knots should be placed upon the mucous surface in the manner described later.

Care must be taken to keep the thread always taut, and the turns
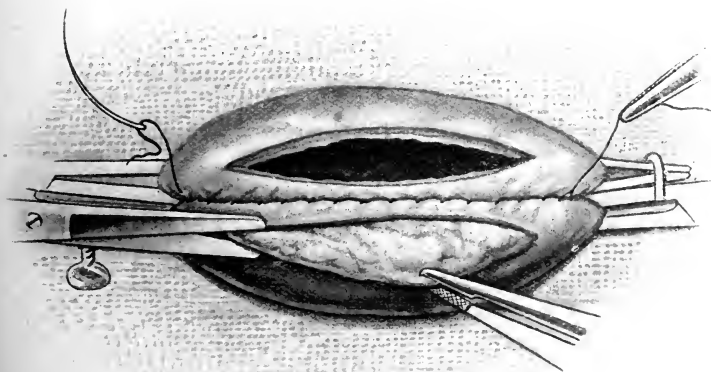
FIG. 90. Posterior gastro-jejunostomy. The prolapsing mucosa of the jejunum is being removed with scissors. The stomach has been similarly treated.
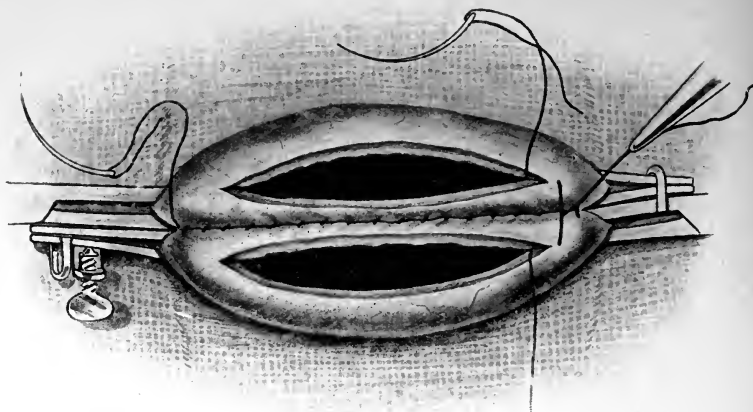
Fig. 91. Posterior gastro-jejunostomy. Note the mode of starting the second or perforating suture.

should not be more than one-eighth of an inch apart. These precautions secure accurate apposition of the mucous membranes, and especially prevent hæmorrhage. The clamps are now removed, and if the deep suture has been properly applied, very little bleeding occurs. An additional turn or two of suture is applied at any bleeding spot. The exposed parts are cleansed with moist sterile swabs. All instruments, which may have been contaminated from the mucous membranes, are discarded. The gloved hands are washed in lysol 1 in 100 and rinsed in saline, and two clean towels are placed around the wound. The sero-muscular suture is now continued after the method of Lembert or Cushing. The latter leaves none of the thread exposed, and therefore lessens the chance of adhesions. When the circle is nearly complete the assistant holds up the tail thread at the starting-point, while the surgeon carries the last turn
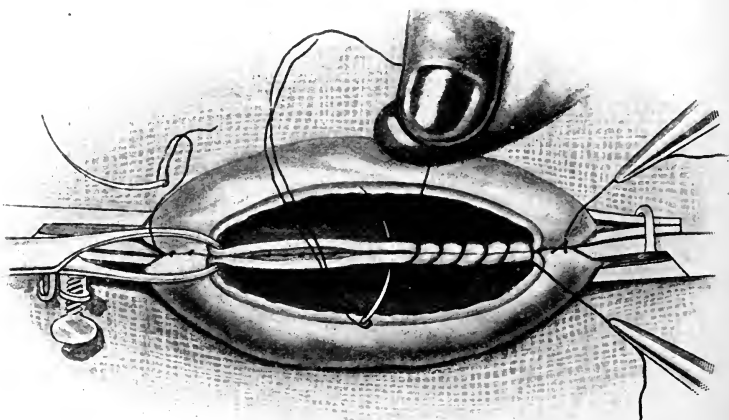
Fig. 92. Posterior gastro-jejunostomy. The perforating suture is always drawn and held taut to prevent hæmorrhage when the clamps are removed.
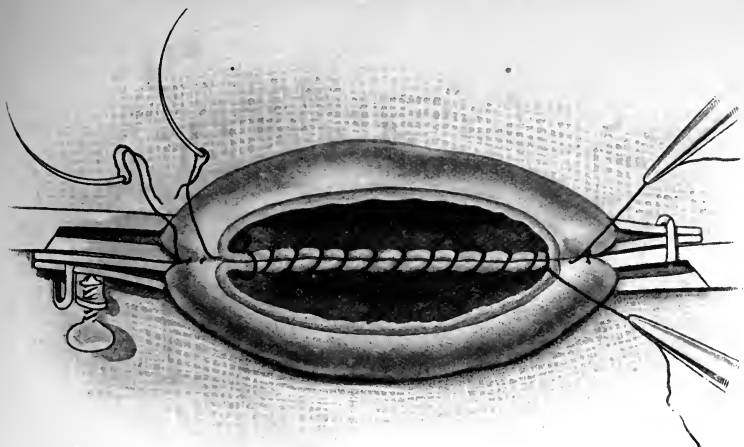
FIG. 93. Posterior gastro-jejunostomy. The perforating suture is well advanced. Note the mode of "turning the corner."

of the suture beyond this point; the two ends are then tied together. The whole circle of union is now examined, and if necessary a reinforcing suture may be placed at any weak spot (*see* Fig. 95).

The gauze packs are removed and the parts cleansed. The transverse colon is brought out again, and drawn forward so as to expose the rent in its mesentery to enable the surgeon to fix its margins to the jejunum or stomach (*see* Fig. 96). Failure to do this may lead to the formation of an internal hernia. I have operated upon one patient in whom the anastomosed loop had been drawn into the lesser sac, and had become constricted by the contraction of the mesocolic incision and the formation of adhesions.

Three sutures are sufficient, one in front and one at each side.
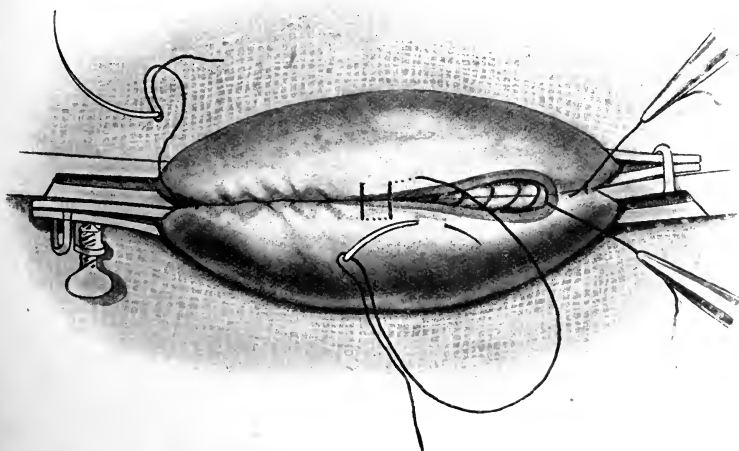
FIG. 94. Posterior gastro-jejunostomy. The perforating suture is nearly completed after Connell's method. The knot is placed within the lumen.
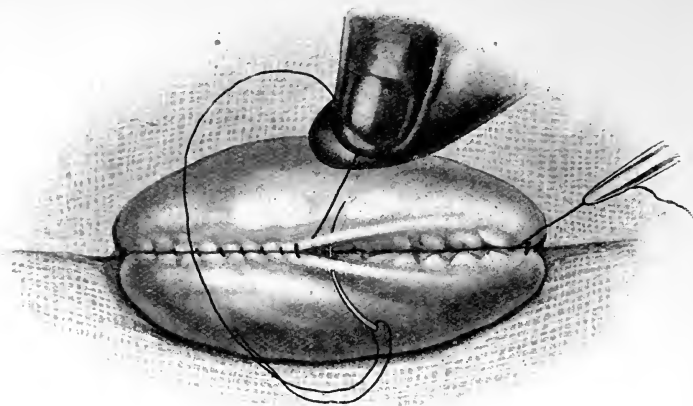
Fig. 95. Posterior gastro-jejunostomy. The continuous sero-muscular suture
is nearly completed.

Mattress sutures are used and passed in such a manner that they turn the
raw edges of the rent upwards into the lesser sac so as to lessen the risk
of adhesions below with kinking of the jejunum. The mesocolic vessels
must be carefully avoided. These sutures pick up the stomach or the
jejunum or both near the anastomosis.

Mayo's Method of Posterior Gastro-jejunostomy without a Loop. In
the old no-loop operation of posterior gastro-jejunostomy the part of the
jejunum engaged in the anastomosis was turned to the right so as to be
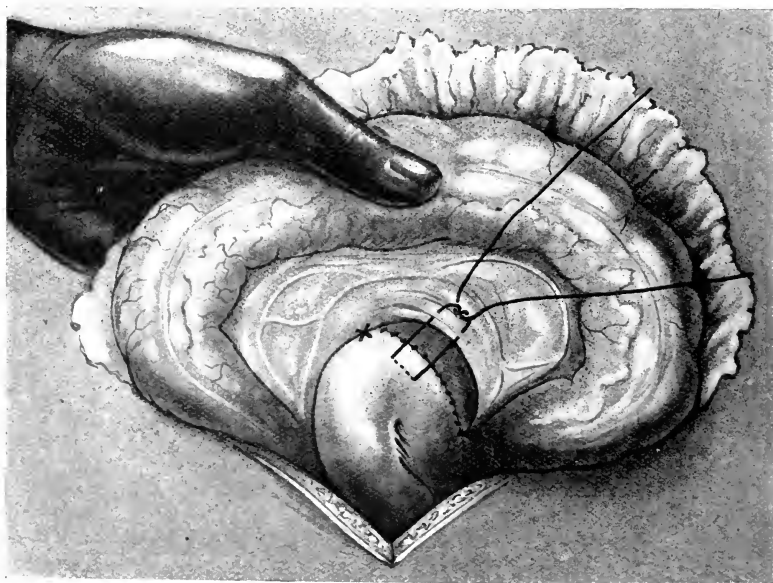
Fig. 96. Posterior gastro-jejunostomy. The opening in the mesocolon is
closed.

iso-peristaltic with the stomach. The results were, on the whole, good, but Dr. W. J. Mayo [1] published two cases in which chronic bile regurgitation of a serious character developed. In each of these "the occasional regurgitation of quantities of biliary and pancreatic secretions was a source
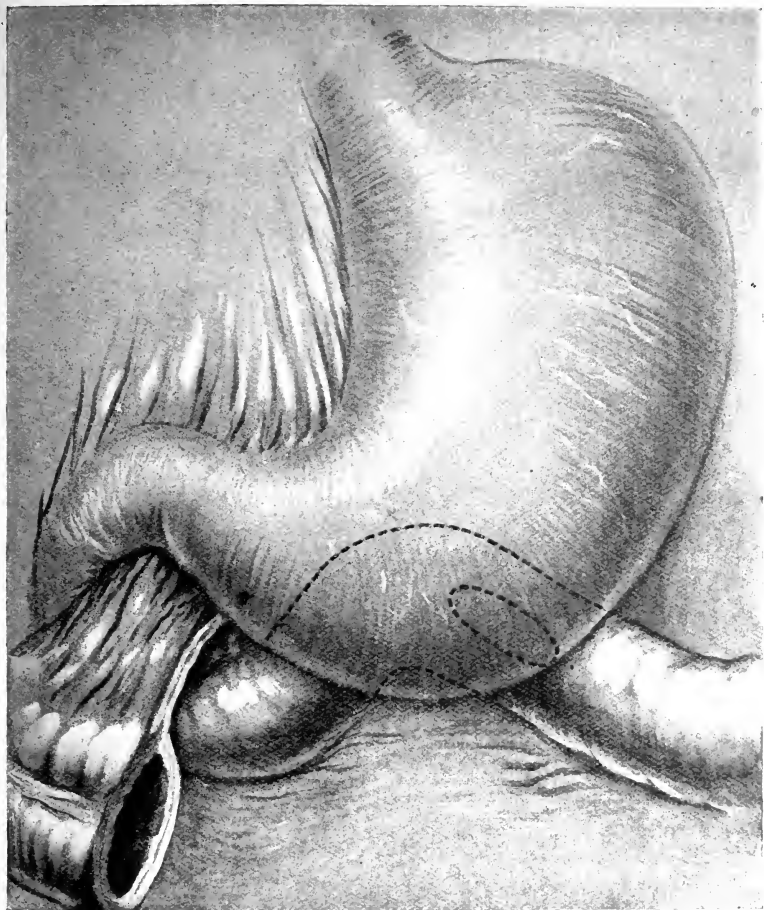
Fig. 97. Posterior gastro-jejunostomy after Mayo's method. The jejunum is not turned to the right. (After Mayo, *Ann. of Surg.*)

of great discomfort and considerable disability. Reoperation in both cases during the past summer (1905) showed that the cause of the trouble was an angulation of the jejunum at its gastric attachment." These troublesome symptoms occurred after two out of fifty-six no-loop operations performed between January 1 and July 1, 1905, with only one death.

These cases led Dr. Mayo to doubt whether it is really necessary to reverse the direction of the jejunum so that it runs in the same direction as the stomach. He maintained that the jejunum normally ascends a little from its origin towards the left and then falls downwards and backwards towards the left kidney pouch. If the bowel is turned well to the

[1] *Ann. of Surg.*, 1906, vol. xliii, p. 537.

right kinking may occur at the anastomosis.   Therefore it seemed to him a mistake to court kinking by turning the jejunum to the right, especially as it is of no advantage to have the attached jejunum iso-peristaltic with the stomach.

The only essential difference from the usual no-loop operation as described above is that the incision in the posterior wall of the stomach runs very obliquely downwards and to the left instead of almost vertically downwards, so that the attached jejunum may also run downwards and to the left.   The whole of the opening in the stomach is quite close to the lower border (*see* Fig. 97).

As the first piece of the jejunum is free to move in either direction Sir Berkeley Moynihan, who formerly rotated the jejunum to the right, believes the vertical or mid-position the commonest and the one least likely to cause kinking.   I have used both methods extensively, and have returned to Mayo's method as I believe it gives the best results.   When the stomach is either small or fixed the Mayo method is easier.   When this is adopted the opening in the stomach must not be too far to the right, otherwise angulation may occur with partial obstruction of the proximal jejunum.   Whichever operation is adopted the opening in the jejunum must be as near as possible to the duodeno-jejunal flexure.

(2) ANTERIOR GASTRO-JEJUNOSTOMY.

After the stomach has been thoroughly examined the lowest part of the greater curvature is selected.   Long curved clamp forceps are applied obliquely with their handles towards the left shoulder, and their points below the greater curvature near the pylorus.   The fold included in the forceps should be four inches long and empty.

The duodeno-jejunal flexure is found in the way already described, and the jejunum is traced downwards for about six to eight inches, where it is clamped and joined to the stomach.   It is important actually to follow the bowel from its origin.[1]

The selected loop of jejunum should be so arranged that its distal part may be nearest the pylorus, and lowest upon the stomach so that drainage into the proper limb may be facilitated.   The details of suturing are the same as already described.

To prevent kinking a few sutures should be inserted to fix the proximal limb of the jejunum to the stomach above and to the left of the anastomosis.   This can be done by carrying the sero-muscular suture well beyond and to the left of the stoma.   To prevent rotation the opening in the jejunum must be on the side of it lying in contact with the stomach and not on the free border.   It is important to make the opening low enough in the jejunum to allow easy approximation of the parts without tension,

[1] If the piece of small intestine which emerges below the colon be chosen, it may prove to be low down in the ileum.   If the wrong end of the small intestine be thus attached to the stomach, the food taken will not be subjected to the natural processes of digestion and absorption and the prolongation of life will be brief.   The importance of the above is proved by the fact that the above accident has occurred to operators of such experience as Mr. H. W. Page (*Med.-Chir. Trans.*, vol. lxxii, p. 379).   Here the intestine attached to the stomach was the ileum, nine inches from its lower end.   This patient lived for ten weeks and, though greatly relieved from vomiting and nausea, began to lose ground at the end of six weeks.   Mr. Page quotes some other cases, a striking one being that of Lauenstein (*Cent. f. Chir.*, 1888, p. 472).   Here the intestine opened was only fifteen inches from the ileo-cæcal valve.   The patient began to have diarrhœa on the fourth day, passed unchanged food in her stools, and died on the eleventh day.

and without compression of the colon; but the danger of intestinal obstruction from this cause has been greatly exaggerated. On the other hand, the chosen spot must not be low enough for the loop to produce a potential hernial aperture (*see* Fig. 98).

In some stout patients with bulky great omenta, the latter may have
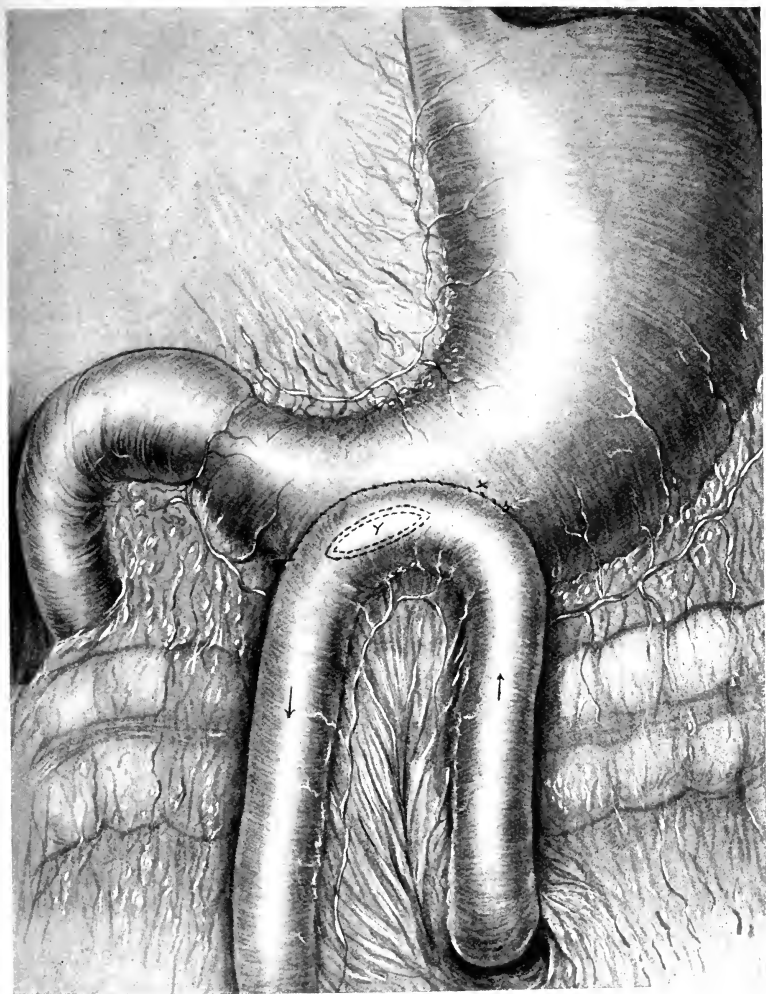

Fig. 98. Anterior gastro-jejunostomy. The jejunal loop is brought up in front of the great omentum and transverse colon without compressing the latter. The stoma is at the lowest part of the pyloric segment of the stomach. Kinking is avoided by an extensive attachment of the jejunal loop to the stomach.

to be slit vertically to allow the proper part of the jejunum to be brought to the stomach without tension and without troublesome folding of the great omentum.

(3) **Roux's Y Method.** Wölfler first suggested this operation, which has been improved and popularised by Roux. The jejunum is cut across

and the distal portion is joined to the stomach either posteriorly or anteriorly. The proximal end is implanted into the left side of the distal part. The stomach is clamped in the usual way, and the jejunum is divided between two intestinal clamps, holding the bowel and the mesentery. It is simpler to secure a loop of bowel and its mesentery with one long clamp. For the posterior operation the division should be about
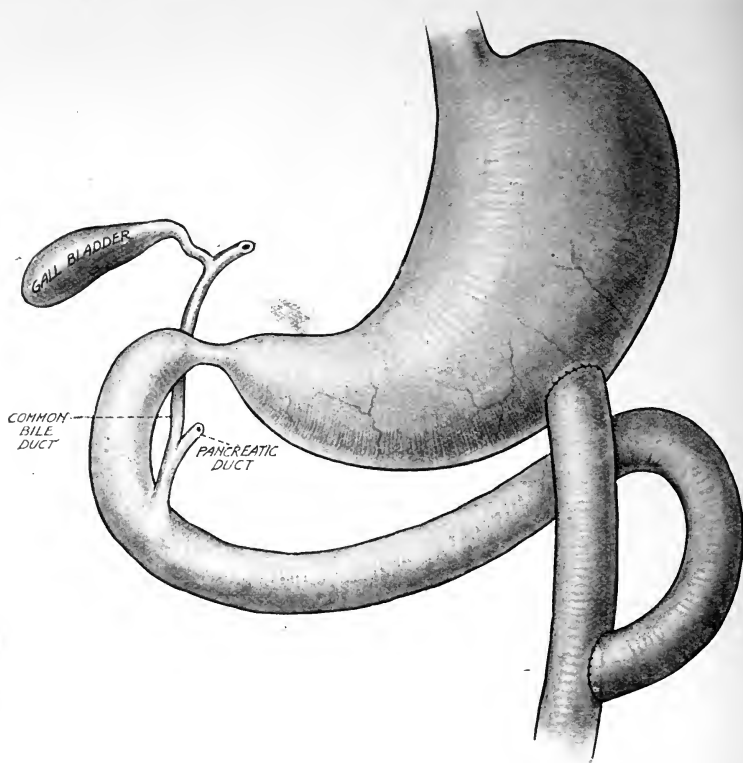
FIG. 99. Roux's Y method of gastro-jejunostomy. The opening in the stomach may be either anterior or posterior, preferably the latter.

six inches from the duodeno-jejunal flexure. For the anterior operation the jejunum may be conveniently divided about twelve inches from its origin. The mesenteric vessels are secured by transfixing and ligaturing the mesentery behind the clamps (*see* Fig. 99). The distal part of the bowel is then joined to the stomach by two rows of sutures, and the proximal end to the left side of the distal part at least three inches below the stomach, otherwise bile and pancreatic juice may regurgitate into the stomach. An elliptical piece of gastric mucosa is excised in order to secure a patent anastomosis.

The advantages of the Y method.—(1) It is the surest method of preventing " vicious circle." It is impossible for food to pass from the stomach into the proximal loop, and it is difficult for bile, pancreatic juice and intestinal contents to enter the stomach through the gastro-enterostomy. (2) It provides an excellent means of emptying the stomach without delay, and for this reason it is recommended by Kocher

for all cases in which this is essential, especially in malignant or other cases with early decomposition of the gastric contents.

The disadvantages are : (1) That the two anastomoses make the operation more complicated and prolonged, so that it is not suitable for grave cases, or routine use. (2) Now that " regurgitant " vomiting is known to be preventable by simpler means, and effectual drainage
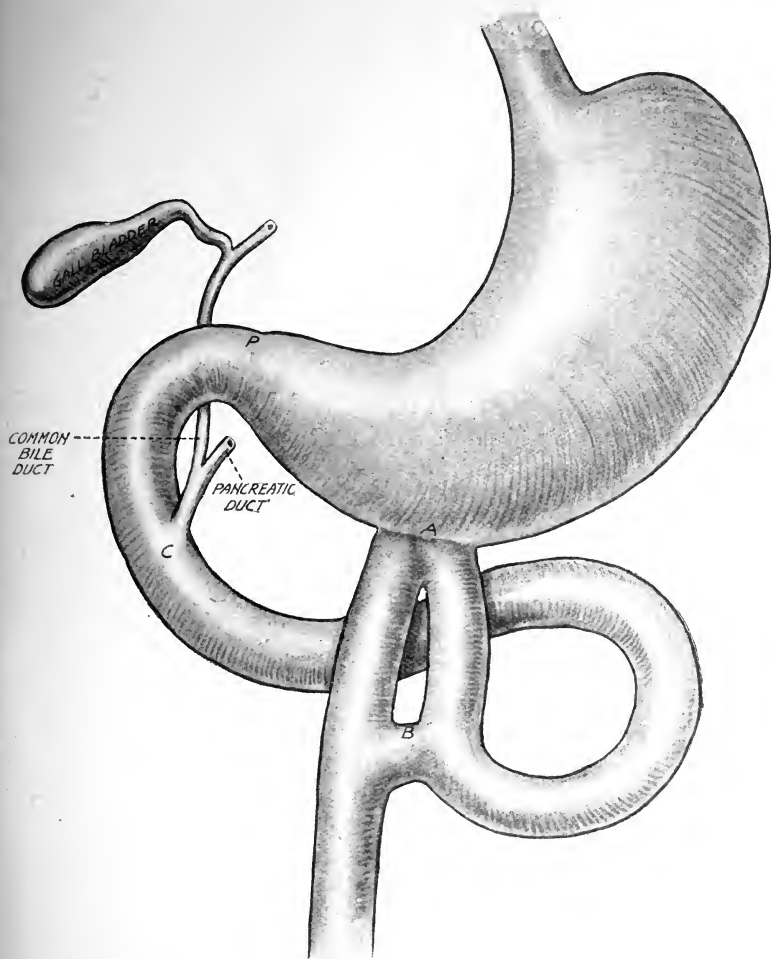
FIG. 100. Gastro-jejunostomy with entero-anastomosis.

can be provided by making a large opening suitably placed, it is no longer necessary to use Roux's more tedious and serious method. (3) The danger of peptic jejunal ulcer is increased because a portion of the bowel is exposed to the action of the gastric juice, without the neutralising effects of the bile and pancreatic juice. In malignant disease this objection does not hold, for jejunal ulcer has not yet been known to follow in carcinomatous cases.

(4) **Gastro-enterostomy with entero-anastomosis** (Braun, Jaboulay and Weir).—This, a simpler but less effectual method, which has been

designed for the same purpose and has the same objections as Roux's method. Entero-anastomosis has often been resorted to for vomiting coming on either early or late after loop operations, and it has generally but not always proved successful. The anastomosis is made between the limbs of the loop about three inches below the gastric attachment (*see* Fig. 100).

Gastro-jejunostomy and entero-anastomosis with occlusion of the proximal limb of the loop, either with the silver wire ligature of Fowler,[1] or the Scott-Mattolli suture is not to be recommended, for all these complicated and tedious procedures are unnecessary and they have nearly all the objections of loop operations with entero-anastomosis. Further, ligation or plication may not be effectual in preventing the chyme from entering the afferent limb, or may even cause troublesome adhesions necessitating operative treatment as in one of Mayo's cases.

To attempt to partially occlude the proximal limb without effecting entero-anastomosis lower down is simply to court disaster. If the pylorus is patent enough to allow any food to pass on into the duodenum, the afferent limb then becomes greatly distended from true intestinal obstruction, which can only be relieved by a secondary entero-anastomosis, which may have to be performed under unfavourable circumstances.

COMPLICATIONS AND SEQUELÆ OF GASTRO-JEJUNOSTOMY

Fortunately these are rare at the present day, owing chiefly to the great improvements in the technique of the operation and, to a lesser extent, to the greater care in the preparation and after-treatment of the patient, and also to the more accurate knowledge of the indications for and against operation. But even with the greatest care complications do occasionally arise, so that a careful consideration of them is essential. Only those peculiar to this operation will be considered here, for those common to all abdominal operations have been already dealt with in Chapter I.

(i) **Hæmorrhage.** Serious bleeding very rarely occurs, but when it does it generally comes on within twenty-four to forty-eight hours of the operation. It may take place from the anastomosis, from the ulcer, or from damaged gastric mucous membrane. It is nearly always due to imperfect sewing and is therefore avoidable by great care in applying the deep continuous suture. The turns of this should be so close together and drawn so tight as to prevent the possibility of bleeding. Care must be taken to pick up all the coats at each turn. Some surgeons believe that the bleeding is due to the use of clamps, but I am convinced that it is due to imperfect sewing. Strong clamps roughly used may damage the mucous membrane at the line of their application, and this may lead to hæmorrhage ; but only elastic clamps should be used, and they should be gently but firmly applied. Similarly to avoid bleeding from the ulcer the greatest gentleness must be used in handling it, and whenever possible it should be infolded by sero-muscular sutures. This effectually prevents hæmorrhage from the ulcer.

It is not wise to raise the blood pressure too much by infusion in old people ; for this reason I only give salines in moderation and by the rectum or axilla and not directly into a vein.

Treatment. When bleeding does occur in any serious quantity it soon causes vomiting and pain from distension of the stomach. All liquids

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[1] *Ann. of Surg.*, vol. xxxvi, p. 695.

by the mouth are at once stopped, an injection of morphine gr. $\frac{1}{4}$ is given
to ease pain, keep the patient at rest, and to lower the blood pressure,
and the stomach is washed clean with a soft tube.   The patient rarely
succeeds in emptying and cleaning his stomach by vomiting, and very soon
the blood decomposes and may even send the temperature up or cause
diarrhœa.   Moreover distension of the stomach is a potent cause of the

FIG. 101.   Posterior gastro-jejunostomy.   The opening is into the jejunum
close to the duodeno-jejunal flexure.   The jejunum has been rotated to the
right, causing angulation.   (Mayo, *Ann. of Surg.*)

continuance of bleeding.   Hence it is necessary to use the stomach tube,
which can do no harm.   About 4 ounces of sterile water containing 2 drams
of 1 in 1000 solution of adrenalin chloride is left in the stomach.

(ii) **Regurgitant Vomiting.**   Vomiting is exceptional after the modern
operation, especially when the oblique or sitting up position is adopted.
In a few cases, however, vomiting of a serious character develops either
within a few days or weeks of the operation.   Bilious fluid regurgitates
in large quantities at various intervals, usually without effort or pain.
This is due to intestinal obstruction at the anastomosis.   This may be
early and complete when it rapidly leads to death unless relieved by
operation (acute vicious vomiting), or it may be partial and slow of develop-
ment, vomiting occurring only about once every two or three weeks.

Occasionally early vomiting is due to temporary swelling with valvular
formation at the anastomosis which is too small, with paralytic distension
of an overloaded stomach.   The stomach may be distended with bile and
pancreatic juice, blood or food.   Washing out generally stops the vomiting
at once, but it may have to be repeated several times.   Sometimes
vomiting continues for several days in very nervous women, without any
obvious cause.

In nearly all cases vomiting is due to faulty technique resulting in obstruction of the jejunum. This may consist of angulation, flattening, or rotation of the bowel at the anastomosis, obstructing either the afferent or efferent limb or both (*see* Fig. 101). All degrees of obstruction occur; slight degrees do not cause vomiting or other symptoms except in nervous patients. Complete or nearly complete obstruction causes severe epigastric

Fig. 102.   Entero-anastomosis for vicious vomiting occurring after the modern posterior operation. This may be very difficult.

pain and frequent vomiting with intolerable thirst, and all the signs of a high intestinal obstruction. Acute regurgitant vomiting was not uncommon after the anterior operation, and led many surgeons to perform enteroanastomosis as a routine measure in order to anticipate and prevent it. Chronic vicious vomiting is more common after posterior operations and may require the formation and contraction of adhesions about the anastomosis and mesocolon for its full development. It is often due to the opening in the jejunum being a little too low so that a short loop is left between the duodeno-jejunal flexure and the anastomosis. It has been shown to be due to ascent of the jejunum at the anastomosis into

the lesser sac with a retracting stomach, and the opening in the mesocolon has contracted round the bowel producing an abrupt kink.

In a normal individual the passing of bile and pancreatic juice into the stomach without retention there does not cause vomiting, but it may do so in a nervous patient.

Generally the afferent limb of the jejunum is obstructed at or near the anastomosis and it becomes dilated and œdematous.   An X-ray examin-
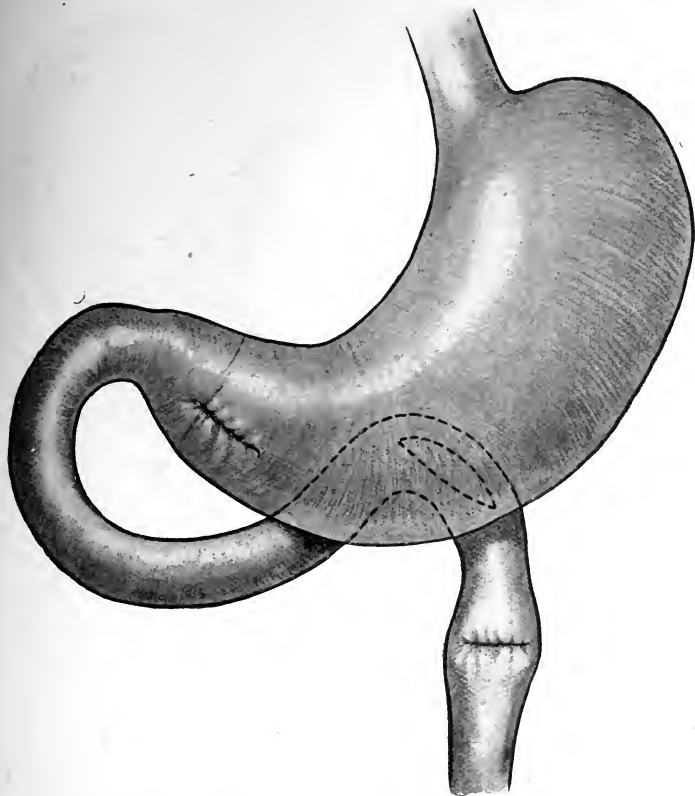
FIG. 103. Radical operation for gastro-jejunal ulcer. The openings in the stomach and jejunum were closed and a posterior gastro-jejunostomy performed.

ation often shows that a bismuth meal passes freely into the efferent jejunum.

Treatment.   Lavage should be tried without delay and repeated if necessary.   It is often effectual.   Limitation of fluids by the mouth, small doses of pituitary extract or strychnine, and rectal salines are also indicated.   Failing relief in this way an operation must be performed for severe vomiting without delay.   An anastomosis is made between the afferent and efferent jejunum, as far away from the anastomosis as the length of the afferent limb will allow.   After the modern operation this may be difficult.   Mobilisation of the fourth part of the duodenum, after dividing the peritoneum to the left of it, facilitates the operation (*see* Fig. 102).

Although this has nearly always relieved it has not always cured, for some of the contents of the afferent jejunum can still reach the stomach.

Narrowing the afferent limb above the entero-anastomosis by an enfolding or circular suture is a simple way of adding to the efficiency of the operation. The most certain way, however, is to divide the afferent limb just below the gastro-jejunostomy, close its gastric end and implant its duodenal end into the side of the efferent limb, four inches below the

Fig. 104. Radical operation for gastro-jejunal ulcer. The jejunum was detached and closed, and gastro-duodenostomy performed. The old gastric opening was pared.

stomach, after Roux's method. I have found this method very effective in these cases (see Fig. 99).

(iii) **Intestinal obstruction** of a different kind may occur sooner or later after gastro-jejunostomy, but it is not always due to the operation. The small intestine has herniated through the mesocolon into the lesser sac. This can be prevented by closing the opening with sutures. The small intestine has passed from either side above the proximal limb of the jejunum and its mesentery thus entering a ring formed by the jejunum, transverse mesocolon, anastomosis and spine. This can be prevented

by placing the opening in the jejunum high enough and by suturing the afferent jejunum to the mesocolon. When a loop is left between the end of the duodenum and the anastomosis it may pass between the
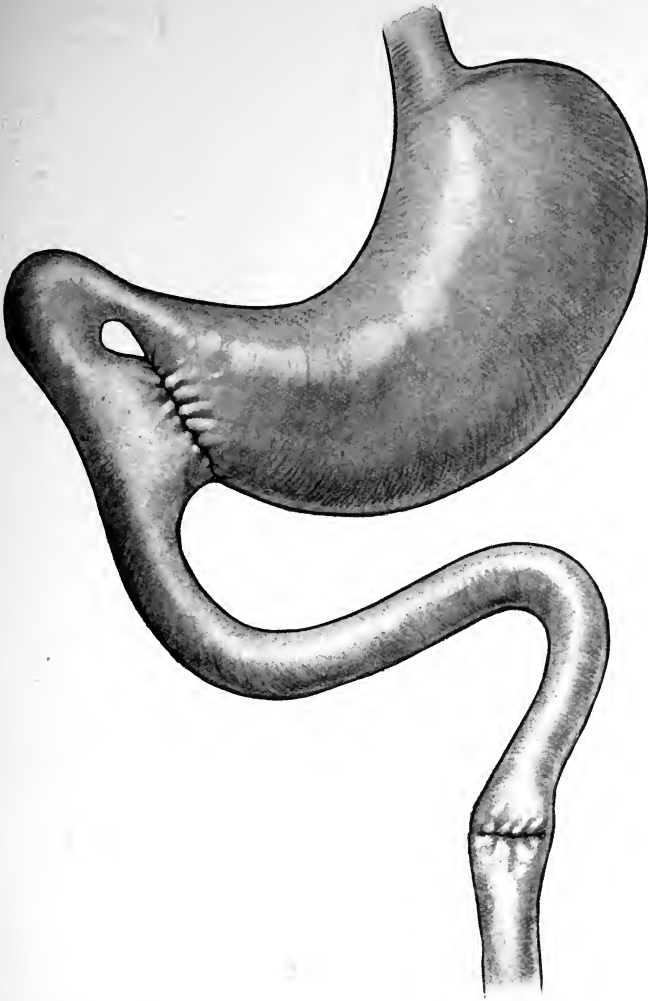
Fɪɢ. 105. Radical operation for gastro-jejunal ulcer following anterior gastro-jejunostomy.

mesentery of the jejunum engaged in the anastomosis and the transverse colon, where it may get obstructed.

(iv) **Jejunal ulcer or gastro-jejunal ulcer.** So far about one hundred instances of this grave complication have been recorded, and the risk of it has been estimated at about 1·5 per cent. Two-thirds are jejunal and one-third gastro-jejunal. It has never been known to follow gastro-jejunostomy for non-malignant disease, probably due to the deficiency of acid in the gastric juice in this disease. It is particularly liable to follow when some of the jejunal mucosa is exposed to the undiluted gastric

juice, and it is therefore only common when an entero-anastomosis or Roux's EnY operation is performed. It is more likely to follow when the stomach is ill-drained and over-acidity persists, and therefore a small stoma aids its formation. However, it may follow the modern no-loop operation performed with the greatest care, for a good deal depends in the after-treatment, neglect of which may reproduce the causes of the original
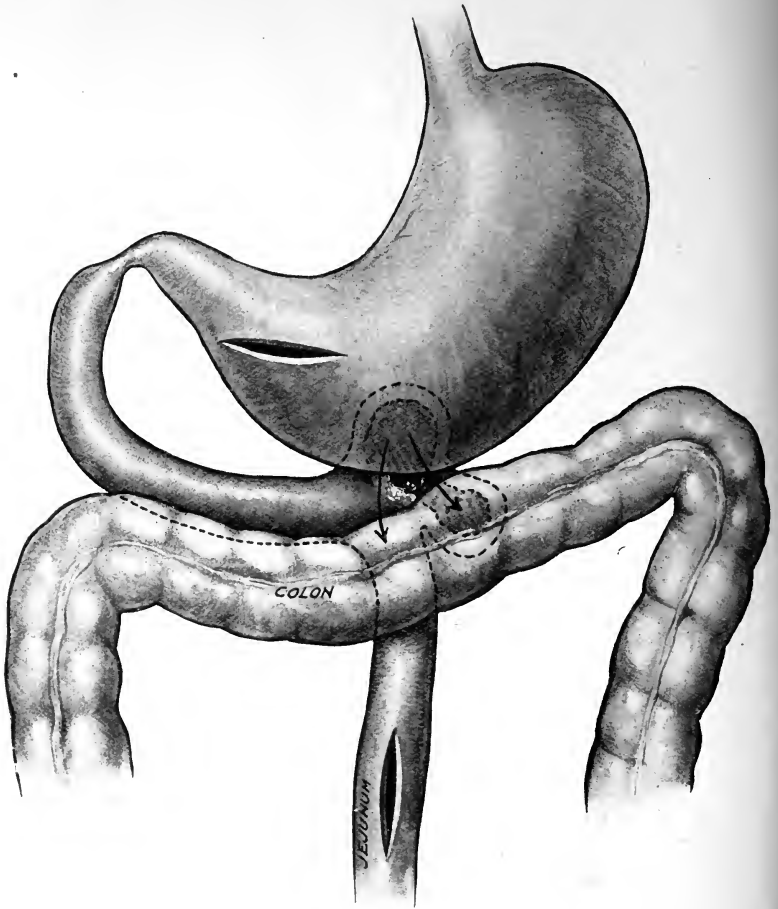
Fig. 106. Gastro-jejunal ulcer with fistula into the colon. Anterior gastro-jejunostomy was done, but failed to save the patient.

ulceration of the stomach or duodenum. The too early return to solid irritating food may delay the healing of the wound and lead to ulceration at the stoma. The use of unabsorbable sutures may similarly delay the healing of the stoma. Medical treatment should be thoroughly tried, such as complete rest in bed for several months, dieting with albuminous and fatty foods, and the administration of alkalies. Failing these a radical operation should be performed.

Radical Operation. This may tax the skill, ingenuity and resource of the best surgeon.

(1) *Enlargement and improvement of the anastomosis after Finney's method.* Page 179.

(2) *Detachment of the jejunum from the stomach with excision of the ulcer or ulcers and the performance of a more perfect gastro-jejunostomy (see* Fig. 103). I have found this very satisfactory.

(3) *Detachment of the jejunum, excision of the ulcer, suture of the jejunum and gastro-duodenostomy.* When the gastro-jejunostomy has been anterior this operation is probably the best, and has the merit of leaving no part of the duodenum or jejunum exposed to the undiluted gastric juice (*see* Figs. 104 and 105).

When there is a gastro-jejuno-colic fistula :

(*a*) *Another gastro-jejunostomy* may be performed as in one of my cases. This patient, who suffered from this complication after a healthy interval of four and a half years, was too ill at the second operation to stand any extensive operation. I therefore performed antero-gastro-jejunostomy to drain his redilated stomach. Another posterior operation was impossible without disturbing the old anastomosis and the fistula into the colon (*see* Fig. 106).

(*b*) *Excision of the ulcerated area* with the formation of a new gastro-jejunostomy at the old site in the stomach, and the closing of the opening in the colon without narrowing the lumen. This is a formidable operation, and my patient was obviously too ill to stand it.

(v) **Diarrhœa.** This sometimes follows gastro-jejunostomy in feeble marasmic patients usually the subjects of malignant disease. It is probably infective in origin and is chiefly due to the decomposition of the products of the new growth.

PYLOROPLASTY. FINNEY'S OPERATION. GASTRO-DUODENOSTOMY

Pyloroplasty as originally introduced by Heinecke and Mikulicz has been very properly abandoned for more radical methods. An incision two inches long was carried along the anterior wall of the stomach through the stenosed pylorus into the duodenum, and this incision was sewn in the reverse direction so that the suture line became transverse to the axis of the bowel, which was thus considerably enlarged. For a time some
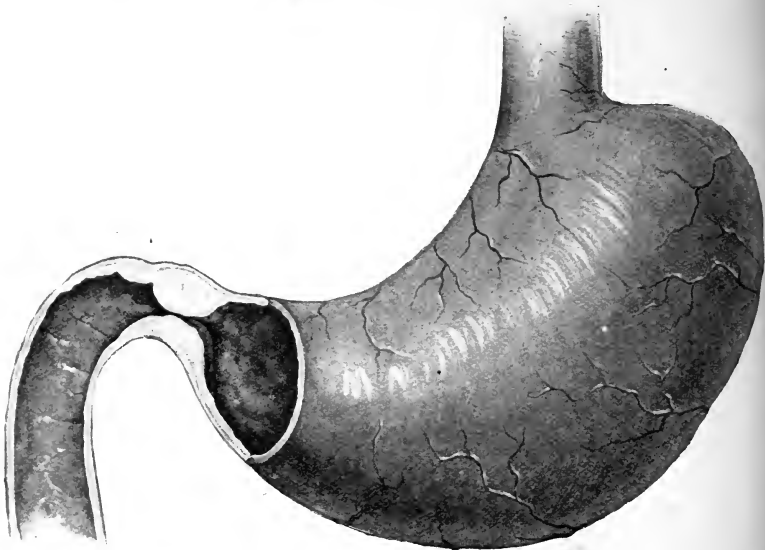
Fig. 107. Pyloric obstruction.

relief usually followed, but recurrence of ulceration and stenosis frequently ensued, and secondary gastro-jejunostomy had to be performed. The operation has been more successful for congenital hypertrophic stenosis, but even for this Finney's modification is much better.

Finney's Operation.[1] Dr. Finney described his ingenious operation as a new method of pyloroplasty, but it is also a form of gastro-duodenostomy. The abdomen is opened through the upper part of the right rectus. The pylorus, the pyloric end of the stomach, and the first part of the duodenum are thoroughly freed from adhesions, so that the subsequent steps may be made easy and all tension prevented. Finney lays

[1] *Bull. Johns Hopkins Hosp.*, July 1902.

FIG. 108.   Finney's operation.   The incision is along the contiguous borders of the stomach and duodenum, a quarter of an inch in front of the great omentum
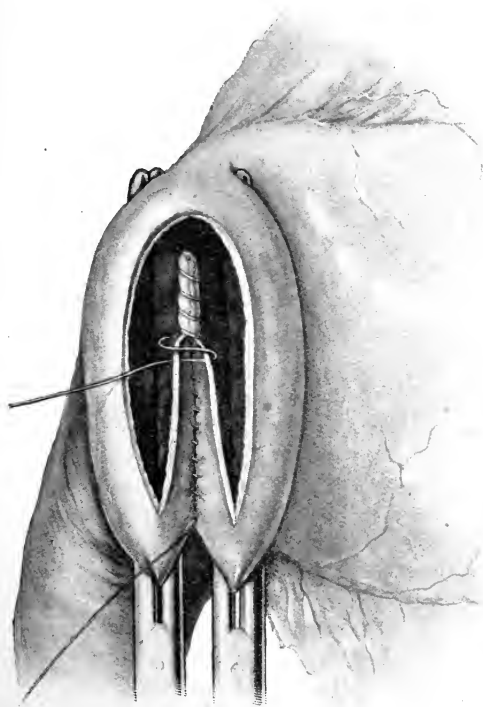
FIG. 109.   Finney's operation.   The two continuous sutures are shown.

stress on the need of separating the adhesions very thoroughly, and considers this to be one of the most essential points of the operation.

The duodenum is mobilised after Kocher's method so that the parts employed in the anastomosis can be brought out of the wound. Sometimes a rubber cushion or Lilienthal bridge under the loin is of considerable assistance. Clamps with their points directed upwards are applied to folds of the contiguous surfaces of the stomach and duodenum. As the incision to be presently made extends along the lower border of the pylorus, the clamps cannot include the whole of the parts engaged in the anastomosis. In spite of this they serve to prevent leakage and to bring
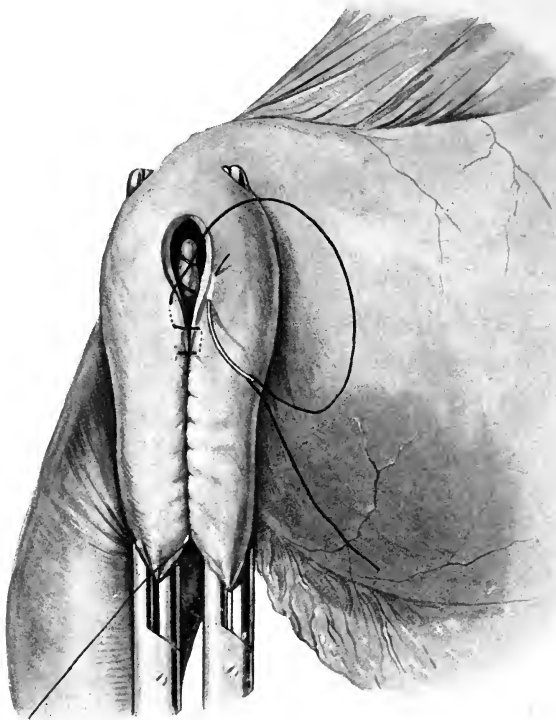
Fig. 110. Finney's operation. The deep suture is nearly completed after Connell's method. This is supported by continuing the Lembert suture upwards in front.

the parts well into the wound. Packs are carefully placed, the posterior part of the sero-muscular suture is inserted, and a quarter of an inch in front of this a long curved incision is made. The incision divides the stricture near its lower border and extends for two and a half inches into the stomach and duodenum (see Fig. 108). To limit subsequent contraction, as much of the scar as possible is excised from either side of the incision, especially if the walls of the pylorus are much thickened. To prevent the formation of obstructing valves, and to make suturing easier, redundant edges of mucous membrane are removed. Any hæmorrhage at the upper end of the wound is arrested, and the posterior edges of the incision are joined together by means of a continuous catgut suture, which pierces all the coats of the stomach and intestines and commences above (see Fig. 109).

This is continued in front after Connell's method. The sero-muscular suture is then completed in front. Continuous sutures are better than interrupted, for they make the operation easier, speedier, and safer (*see* Fig. 110).

The advantages claimed for this operation are—that it is easy and simple, and can be performed in a very short time. This is a distinct advantage when pyloric stenosis coexists with hour-glass contraction, and has to be treated after gastro-gastrostomy in a feeble patient. Also that the size and position of the new orifice are such as to provide free drainage of the stomach, unless the latter is greatly dilated; that spur formation and the development of a vicious circle are impossible; there is a peculiar freedom from post-operative nausea and vomiting. This makes the operation peculiarly valuable for nervous women (regurgitation of bile does occur in some cases, however); even a large ulcer may be removed from the anterior aspect of the pylorus, stomach or duodenum without fear of subsequent cicatricial contraction. There is no risk of jejunal ulceration after this operation. It does not interfere with digestion in the duodenum and with the reflex secretion of bile and pancreatic juice; hence absorption should be a little better than after short-circuiting.

Disadvantages. Although the operation is a great improvement on pyloroplasty, the separation of adhesions is troublesome, and may be dangerous. The after-results are not so good as those of gastro-jejunostomy. It is contra-indicated in most cases of active ulceration, or with dense adhesions, and its mortality is higher than that of gastro-jejunostomy. The mesogastrium may be too short or the duodenum may be too fixed to allow easy approximation of the parts that may then have to be joined in the depth of the wound. Finney [1] states that he has performed the operation 25 times, and that he has collected the results of 112 operations performed by twelve surgeons; the death-rate was just under 9 per cent. In 58 of these operations Dr. W. J. Mayo had a mortality of a little less than 7 per cent.[2]

It may be concluded that Finney's operation is neither so safe nor so generally applicable as gastro-jejunostomy, but that for slight dilatation with few adhesions, and in the absence of an irremovable ulcer, it may be occasionally the operation of choice, especially in women.

Gastro-duodenostomy. This operation was designed by Jaboulay with the object of overcoming pyloric stenosis, and yet to allow the food to enter the duodenum for digestive purposes, and particularly with the view of preventing the development of a vicious circle or regurgitant vomiting. Theoretically gastro-duodenostomy is, on these two accounts, better than gastro-jejunostomy, but, as a matter of fact, some bile regurgitation may follow gastro-duodenostomy, if the opening be made as large as in Finney's operation and others. At the present time regurgitant vomiting after a proper gastro-jejunostomy is very rare.

There is no risk of jejunal ulcer following gastro-duodenostomy, and even a duodenal one is extremely unlikely to develop, for the acid chyme now enters quite near the biliary papilla, and is soon neutralised by the bile and prancreatic juice.

This operation is either impracticable or unsuitable for malignant disease, for if the growth is too extensive for resection it is also too extensive for gastro-duodenostomy, and if there is some reason against resection, while the growth is small enough to allow gastro-duodenostomy,

[1] *Lancet*, 1905, vol. ii, p. 327.   [2] *Ann. of Surg.*, 1905, vol. xlii.

the new opening will soon be invaded and obstructed by extension of the growth.

When an active ulcer at or near the pylorus can be excised, a gastro-duodenostomy may be so designed as to do this and drain the stomach at the same time as in Finney's operation (*see* p. 179). When the stomach is considerably or greatly dilated, gastro-jejunostomy is undoubtedly to be preferred, and this operation is both simpler and safer in the great majority of cases. As compared with such unsatisfactory operations as pyloroplasty, gastro-duodenostomy has the great advantage of avoiding diseased tissues.

Although Kocher had previously joined the open end of the duodenum to the posterior surface of the stomach after resection of the pylorus, Jaboulay was the first to suggest gastro-duodenostomy as a lateral anastomosis. He joined the duodenum to the anterior surface of the stomach by making a vertical incision in each, and folding the duodenum over and to the left. This is only possible with a very movable duodenum, or after making it mobile by Kocher's method. Prof. Kocher gives the following description of his method.[1]

The delicate layer of the parietal peritoneum covering the kidney is divided vertically one and a half inches external to the second part of the duodenum, and the incision is then continued vertically downwards through the upper layer of the transverse mesocolon (which is held on the stretch) as far as the larger branches of the vessels. The fingers are then introduced behind the left edge of the incision through the peritoneum, and the duodenum is separated from the vertical column, the vena cava, and the aorta, until it can be brought forward.

Clamps are applied to folds of the anterior walls of the stomach and duodenum, and an anastomosis is effected as described under gastro-jejunostomy. Packs are carefully placed to isolate the parts.

The method is subject to only one contra-indication, viz. the presence of such extensive adhesions to the under surface of the liver that the duodenum cannot be sufficiently freed. This difficulty of adhesion can, however, often be overcome, as we have proved in three of our cases ; but the fact of having to perform the suturing inside the abdomen is apt to interfere with the security of stitching, especially in difficult cases. It is on this account that sub-pyloric gastro-duodenostomy did not meet with universal acceptance. The sub-pyloric portion of the duodenum cannot be drawn out of the wound, on account of its connection with the gastro-hepatic omentum and the important structures contained within it. This fixation to the under surface of the liver may be so firm that only the lower two-thirds or only the lower part of the vertical portion of the duodenum, together with the inferior flexure, can be brought in contact with the stomach.

We therefore propose that, instead of Villard's sub-pyloric gastro-duodenostomy, the name " lateral gastro-duodenostomy " be given to this operation to distinguish it from our method of inserting the divided duodenum into the posterior wall of the stomach after resection of the pylorus. The great difference between Villard's sub-pyloric gastro-duodenostomy and our procedure is that we render the descending portion of the duodenum, the inferior flexure, and a considerable portion of the third (transverse) part so movable that the parts to be sutured can readily be raised up and surrounded with gauze, so that the sutures can be introduced extra-peritoneally with comfort and security.

It is to be noted that even Prof. Kocher found adhesions troublesome in three out of his five cases. Although the operation may appear easy to him, it is certain that for those of less experience, gastro-jejunostomy is easier and safer to adopt in the large majority of cases.

[1] " Operative Surgery."

CHAPTER XIII

HOUR-GLASS CONTRACTION OF THE STOMACH

FOR a long time hour-glass contraction was thought to be nearly always congenital in origin, but Moynihan has shown that it is almost invariably due to gastric ulcer. The ulcer, which is generally placed at the lesser curvature and extends to the anterior and posterior surfaces of the stomach, gradually contracts and draws the greater curvature upwards. Adhesions also form to the under surface of the liver, to the anterior abdominal wall, or towards the spine. These may drag upon and narrow the stomach. In a few cases carcinoma may give rise to hour-glass contraction, but it is probable that even then a simple ulcer is the primary lesion. The history of my only case of this kind suggests this view. There is little doubt that spasm of muscle around an ulcer also plays an important part in narrowing the tubular orifice joining the two gastric pouches. There is a specimen in the museum at Guy's Hospital showing a moderate degree of hour-glass contraction due to gastrostomy. The situation of the constriction varies a good deal. Usually the cardiac pouch is the larger. In two of my twelve patients the pylorus was also contracted as the result of previous ulceration. In these two the pyloric pouch naturally was dilated, and was even larger than the cardiac.

Hour-glass contraction of the stomach is said to be a very rare disease, but it is not so rare as it is supposed to be, for in five years I have operated upon twelve patients who were suffering from it.[1] The narrowing was due to the contraction of a simple ulcer in ten, and carcinoma had been grafted upon simple ulcer in one case. In one remarkable instance the condition was due to adhesions following gastropexy seven years earlier. The condition would not have been recognised clinically in the majority of my cases without the aid of the bismuth and X-ray method of examination. No operation would have been performed in some of them, and the patients would have died unrelieved with their condition unrecognised. Twice a diagnosis of late carcinoma had been made, and a hopeless prognosis had been given. The bismuth method undoubtedly affords the most reliable means of diagnosis of hour-glass contraction, and it ought to be used more frequently. Most of the patients were extremely ill at the time of operation, and had been invalids for many years. Earlier diagnosis and treatment would have saved them much pain and misery. It is even probable that malignant disease would have been prevented in one case. All the patients fortunately recovered from the operation. The patient with malignant disease, although greatly relieved, died within six months. All the others, except two, are in good health;

[1] Most of this chapter is derived from my paper on this subject in the *British Medical Journal*, March 25, 1911. There my first six cases were reported in full.

one of these after several years of perfect health is now suffering from carcinoma of the larynx. The other, at the age of forty-five, had a baby two years after the operation and was well for four and a half years. Six months ago symptoms of gastric ulcer developed, and the patient said she knew the ulcer was higher than the old one. She was proved correct at operation, a small ulcer being found at the operation to be close to the cardia. Gastro-jejunostomy has immediately relieved the severe pain. Early operation not only lowers the mortality, but makes the restoration of health more complete. The mortality of recorded operations for hour-glass contraction is high, therefore the recovery of these twelve patients, in spite of very grave conditions, is gratifying, and is chiefly due to recent improvements in technique, and in the treatment of patients before and after operation. *In the absence of pyloric obstruction*, gastro-jejunostomy, with the usually large cardiac pouch, is the best operation. In some cases gastro-gastrostomy with a large opening is the most suitable operation, but in two of my patients *pyloric stenosis had to be relieved at the same time*. For this gastro-duodenostomy, after Finney's method, was easily done and was efficacious.

Diagnosis. It is a very striking fact that most of the subjects of hour-glass contraction have suffered from severe gastric symptoms on and off for many years. The chronic course of the disease is dependent upon the position of the ulcer opposite a wide part of the stomach, where it takes a long time to cause obstruction. It is notable that when the ulcer was in the pre-pyloric region the symptoms progressed far more rapidly and terminated in tetany in one of my cases within two years of the first symptom.

Most of the old methods of examination for hour-glass stomach are chiefly of historical interest, although the escape of turbid fluid from the stomach tube after the stomach has been apparently washed clean may be of value. The result of distension with gas may also be useful, especially if two pouches are thus made visible. It is obvious that positive results cannot be expected from these tests if the constriction is at all tight, and these are the very cases in which prompt diagnosis is most important. The bismuth and X-ray test, if carefully applied, is reliable and is by far the best clinical method of finding out if there is or is not hour-glass contraction. It also serves to show if there is pyloric obstruction as well, for in the absence of this complication the bismuth passes from the pyloric pouch into the intestine in a natural way. To obtain accurate results from it, experience and careful interpretation are required, for a casual examination may lead to a wrong diagnosis. It is absolutely necessary to examine the patient both in the vertical and horizontal positions.

(1) Hour-glass contraction has been diagnosed when a subsequent operation has shown that the condition does not exist. Dr. Hertz tells me that the mistake is due to the weight of the bismuth in the lower part of a *dilated* dropped stomach. This drags upon and narrows the middle part of the stomach, giving it an appearance somewhat resembling, but not identical with, that due to hour-glass contraction. If a patient with dilatation of the stomach and gastroptosis be examined upon the screen while taking the bismuth, the latter can be seen to pass *immediately* into the lower part of the stomach, whereas with hour-glass contraction the bismuth takes *a long time to reach* the pyloric pouch. Moreover, the dark line joining the two shadows passes from the *lowest point of*

the upper one when the stomach is merely dilated, but from the *right border* when there is true hour-glass contraction. Spasmodic contraction of the stomach sometimes associated with gastric or duodenal ulcer, or, as in one striking case which I saw, with chronic appendicitis, may simulate real hour-glass contraction, but repeated examinations prevent error. An ulcer upon the lesser curvature and adherent to the liver may so limit the mobility of the stomach as the patient stands as to produce an apparent hour-glass contraction. The constriction of the shadow disappears when the patient assumes the horizontal position.

(2) Hour-glass contraction may be overlooked when the stricture is very tight, unless the screen examinations are repeated several hours after the bismuth meal is taken. The bismuth meal was used for all my patients, and in all of them it was successful. Other methods of examination were used, but the result compared very unfavourably with those obtained by the bismuth method.

Treatment. The experience of pyloric constriction and the past history of hour-glass contraction make it clear that medical treatment by dieting and lavage should not be continued if the patient is losing ground. The risk of operation is slight if undertaken before the obstruction is severe, and before the general condition of the patient has been allowed to get bad. It is particularly necessary to operate without delay when ulceration is present, for even if the ulcer does heal as a result of medical treatment, this must lead to an increase of the obstruction. Moreover, the ulceration may recur or become malignant. The bismuth method gives a good indication of the tightness of the stricture. The first thing to do after opening the abdomen is to explore the abdomen rapidly and then to examine the stomach, the pylorus, and the duodenum thoroughly. Without this precaution it would be easy to overlook either a cardiac pouch or pyloric obstruction. When the condition of the patient allows, the appendix should be removed to prevent future trouble (Case 2). The exact nature of the operation to be performed must depend upon the conditions found upon exploration, for the same operation is not suitable for all cases. A good deal depends upon the size of the cardiac pouch, the presence or absence of ulceration, of pyloric obstruction, and of adhesions. One or more of the following operations may be required :

(i) **Gastro-jejunostomy engaging the cardiac pouch.**

(ii) **Gastro-gastrostomy with or without gastro-jejunostomy or gastro-duodenostomy engaging the pyloric pouch.**

(iii) **Gastro-plasty.**

(iv) **Partial gastrectomy.**

(a) **When there is no pyloric obstruction,** and especially when the pyloric pouch is small, *a single posterior gastro-jejunostomy* is all that is necessary ; the *cardiac pouch*, which is generally large, being easily joined to the jejunum. With an open pylorus there is no fear of stasis in the pyloric pouch (*see* Fig. 111). The condition then differs very little from ordinary pyloric obstruction, for which posterior gastro-jejunostomy is satisfactory. Extensive adhesions on the posterior wall of the stomach or a very small inelastic cardiac pouch may make posterior gastro-jejunostomy difficult or unsuitable ; then either *gastro-gastrostomy* or *anterior gastro-jejunostomy* engaging the cardiac pouch must be performed. *Of these I prefer the former with a very large opening.* In some cases gastro-jejunostomy engaging the pyloric pouch has been added to gastro-gastrostomy.
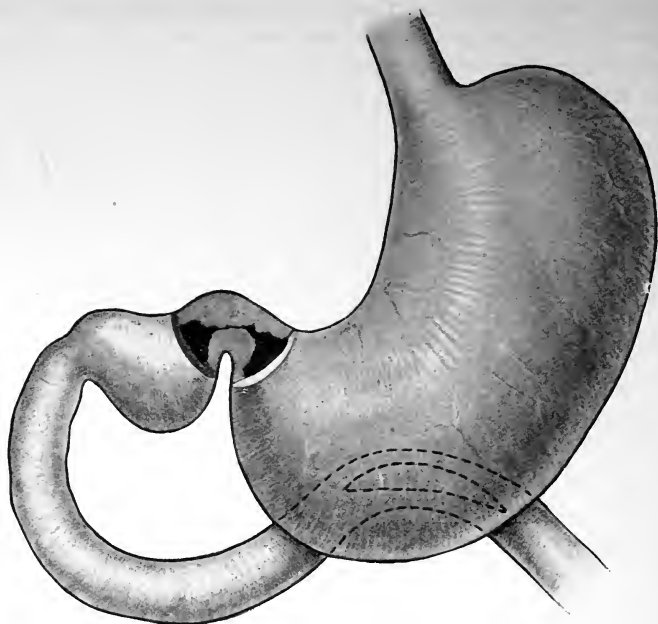
Fig. 111.   Posterior gastro-jejunostomy after Mayo's method for hour-glass contraction with patent pylorus.

Fig. 112.   Gastro-gastrostomy and Finney's operation for hour-glass contraction and pyloric obstruction.

(*b*) **When pyloric obstruction complicates hour-glass contraction** there is some doubt as to the best treatment. Fortunately this complication is not very common. *Double posterior gastro-jejunostomy* is not satisfactory for various reasons. It is difficult to drain the two pouches thoroughly through the limited space available within the loop of blood-vessels in the mesocolon. Moreover, there are usually a great many adhesions to the back wall of the lesser sac, and the transverse mesocolon may be considerably shortened ; and in some instances, as in Case 1, it is impossible to join the jejunum to the posterior surface of the very small cardiac pouch without risk of obstruction of the drawn-up jejunal loop by the contraction of the opening in the transverse mesocolon. *Double anterior gastro-jejunostomy* would be still more unsatisfactory, judging from the results of a single anterior gastro-enterostomy for pyloric obstruction. In some cases a single posterior gastro-jejunostomy may be combined with *gastro-plasty or gastro-gastrostomy*. The jejunum is then joined to the pyloric pouch, but I did not adopt this combination in either of my two cases, because in them the strictured pylorus was freely movable and clearly amenable to treatment by *Finney's operation* (*see* Fig. 112). This, to my mind, is more satisfactory in these cases, because it can be performed in far less time, and particularly because it carries no risk of vicious vomiting, which is still to be dreaded, especially in women, exhausted by years of chronic gastric disease. It may be said that Finney's operation does not drain the stomach so well as gastro-enterostomy, but this depends a great deal upon the size of the opening, which can be made very large by Finney's method. In both my cases there has been no recurrence of pyloric obstruction in four years. It is possible that gastro-jejunostomy, by allowing the bile and pancreatic juice to reach the stomach and neutralise the gastric juice, is a surer safeguard against recurrence of ulceration of the stomach. Gastro-jejunostomy is considerably better when there is active ulceration or extensive adhesion at the pylorus. *As to the relative merits of gastro-plasty* (Kammerer) *and gastro-gastrostomy*, much depends upon the presence or absence of active ulceration, intractable adhesions, and upon the size and accessibility of the cardiac pouch. When there is active ulceration around the tubular stricture, it is clearly better not to cut into the ulcerated area, but to adopt gastro-gastrostomy. Inseparable adhesions, especially with ulceration invading the liver, or a very small cardiac pouch (as in Case 1), make gastro-plasty very difficult and unsuitable, for some of the sewing would have to be done very deep in the epigastrium under cover of the left costal margin. For such cases, at least, gastro-gastrostomy is safer and preferable, although it may not appear to be so perfect in an anatomical sense. It must be remembered, however, that the pyloric is almost vertically below the cardiac pouch in these cases, as shown by the bismuth and X-ray method, and that a gastro-gastrostomy with a very large opening therefore provides satisfactory drainage (*see* Figs. 112 and 113). Usually a *very large opening* can be made in fairly healthy tissues. The aperture should be, whenever possible, at least four inches long. Unless the cardiac pouch is very small this can be provided *if the aperture in the stomach be made curved*, starting about an inch below the stricture and extending about an inch in front of the greater curvature as far as may be required. There is very little tension upon the suture line when this method is adopted. The stricture, which is relatively fixed, is neither displaced nor folded. The very

movable lower borders of the gastric pouches are simply approximated. As far as external appearances go the natural shape of the stomach is almost restored by the operation. Vertical gastric incisions, as figured in some of the books, cannot be made long enough to provide adequate
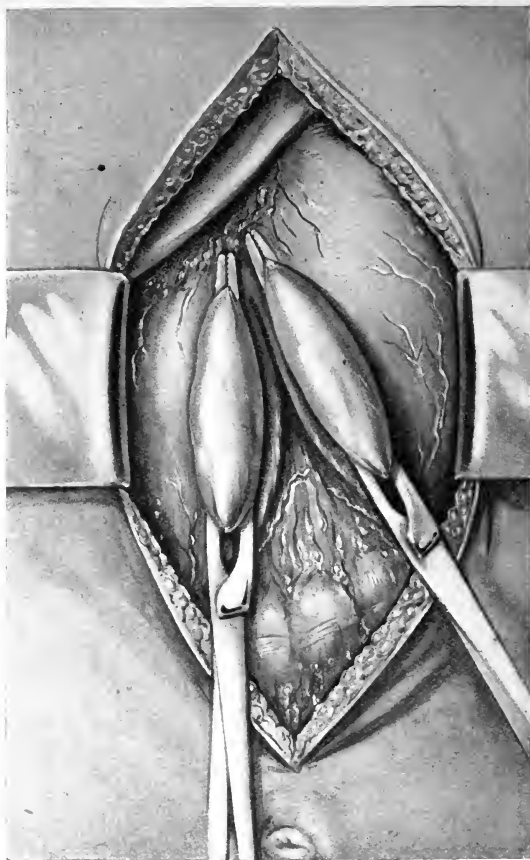

Fig. 113. Gastro-gastrostomy. Clamps are applied to the cardiac and pyloric pouches, and the subsequent steps are similar to those figured under gastro-jejunostomy.

drainage. This is probably the chief reason why recurrence of symptoms has sometimes followed gastro-gastrostomy. In only one of my patients was Kammerer's operation practised, and it was certainly far more difficult than gastro-gastrostomy (see Fig. 114). In some cases it is possible and advisable to excise the ulcer upon the lesser curvature without approaching too near the greater curvature. When the V-shaped opening thus made is closed the narrowing is abolished and the natural shape of the stomach is restored. Excision has the merit of immediately removing an ulcer which is slow to heal, and may be regarded as a possible source of malignant disease. Moynihan[1] records one remarkable case in which it was impossible to join the cardiac to the pyloric pouch owing to

[1] *Med.-Chir. Trans.*, 1904, vol. lxxxvii, p. 143.

adhesions.   In this case he opened the pyloric pouch and *dilated the stricture in a retrograde manner*, and to his surprise the patient made a good recovery.   When hour-glass contraction is due to growth, or there is a reasonable suspicion that the chronic ulcer is becoming carcinomatous, *partial gastrectomy*[1] is the only radical treatment (*see* Fig. 115).   The open end of the duodenum may then be closed, and the jejunum joined to the cardiac pouch.   Occasionally it may be possible to perform a radical operation, and also to join together the remainders of the cardiac and

Fig. 114.   Gastro-plasty and Finney's operation for hour-glass contraction and pyloric obstruction.

pyloric pouches without tension.   When the growth is irremovable, temporary relief may be obtained by joining the jejunum to the cardiac pouch as far away from the growth as possible.   For my sixth patient anterior gastro-enterostomy was the only possible operation, for the carcinoma had invaded the transverse mesocolon.

The essential points of the operations of gastro-gastrostomy and gastro-plasty now require attention.   The other operations mentioned are described elsewhere.   The two illustrative cases reported below give further details.

Gastro-gastrostomy.   It is essential to make the anastomosis as large as possible, especially when gastro-gastrostomy is the only operation performed.   With this object very large pouches of the cardiac and pyloric parts of the stomach are so secured in strong clamps that curved

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[1] Delore and Alamartine (*Revue de Chir.*, March 1909) urge more frequent resection on account of the risk of carcinoma developing in these callous ulcers.

incisions can be made about one inch above and parallel to the greater curvature. The points of the clamps are just below the constriction and their handles below and well to the right and left. The pouches are brought together and joined by two layers of sutures as in gastro-
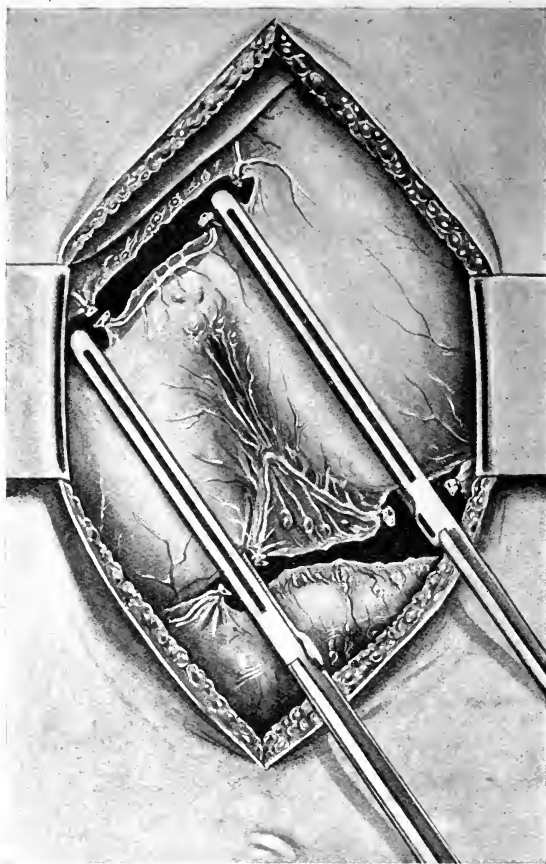
Fig. 115. Excision of the tubular ulcer (? malignant), causing hour-glass contraction. The cardiac and pyloric pouches are then sewn together.

jejunostomy. The deep suture is of strong catgut and the serous of fine linen thread. Packs are carefully placed as usual.

Gastro-plasty needs no special description, for it closely resembles Finney's operation of pyloro-plasty. It is more difficult than gastro-gastrostomy and has the disadvantage of invading inflamed hard tissues.

The following two cases were published in the *British Medical Journal*, March 25, 1911 :

CASE 1. Mrs. M. D., an American lady aged 42, was brought to me by Dr. J. C. Cook towards the end of October 1909.

History. She gave a history of lifelong constipation and indigestion. About ten years ago she began to have attacks of biliary colic about once or twice a year, but these entirely ceased four years ago. She has never been jaundiced. Since she was a girl she has suffered a great deal from indigestion. For the last three years she has had almost constantly a dull pain in the epigastrium, but this has become

a great deal worse within the last few months, and has lately shifted up the sternum as high as the sternal notch, where it is sometimes very severe, especially when the patient swallows. The indigestion has been very bad during the last eighteen months. At first she used to vomit about once or twice a week, but gradually this has increased in frequency to once every day, and lately after every meal containing any solid. She has never had hæmatemesis or noticed melæna. Gradually the amount that she can swallow at a time has diminished. After the food she has a feeling of a lump in the throat and under the breast bone. For months she has not been able to take solid food in comfort. The attempt has always been followed by great pain, which is only relieved by the return of all the food. One day she took an oyster divided into four pieces ; this was followed by great pain and vomiting, which was only relieved when the last piece of oyster was returned four hours later. The only solid that she could occasionally take in comfort was a Welsh rarebit. Occasionally her mouth fills with water, and then she brings up a small amount of mucus. The act of swallowing itself is not painful if the patient is content with a small amount of liquid at a meal. For the last year she has not been able to take tea. For months she has lived on peptonized milk, Benger's food, Brand's essence, and so on, in decreasing quantities at a time. These have been supplemented by nutrient enemata and suppositories. She has wasted progressively for two years, but much more rapidly during the last six months. About two years ago her weight was 130 lb. ; now she is only 56 lb., although she is 5 ft. 9 in. in height. During the last few months she has had several attacks of shivering, associated with exacerbation of vomiting. In spite of all this the patient has led an active life, often travelling two hundred miles a day in her motor-car and managing the business affairs of her daughter. She was taken to see a well-known consulting physician in May 1909, who is said to have diagnosed malignant disease in the abdomen, possibly in the stomach or pancreas. He gave a bad prognosis, and advised that the patient should be allowed to live and do as she liked.

Condition upon Examination. The patient was extremely thin and feeble. She was only able to walk into my consulting-room with difficulty. She was not able to dress or undress herself. Her skin was yellow, dry, and wrinkled. The temperature was 97°. The hands and feet were cold. There was some œdema of the ankles.

Alimentary System. All the natural teeth were missing, having been extracted about fifteen years ago and replaced by complete sets of artificial teeth. The tongue was raw and red. When asked to swallow a glass of milk she was only able to take half a tumblerful in small sips. Any attempt to take more gave rise to pain and a feeling of distension at the lower end of the sternum. The abdomen was carinated, and in spite of the fact that the abdominal wall was very thin, no tumour could be felt anywhere in the abdomen. There was a little resistance in the gall-bladder region, but no dulness or tumour. A succussion splash could be obtained a little below the level of the umbilicus. A pelvic examination revealed no abnormality. The respiratory system was normal, in spite of a history of possible phthisis at the lower part of the right upper lobe. The nervous system was normal except for great irritability of temper. In view of the difficulty of diagnosis between œsophageal stricture and hour-glass contraction of the stomach with pyloric obstruction, an X-ray and bismuth examination of the stomach was advised. Three days later the patient was asked to swallow a tumblerful of milk containing 1 oz. of the oxychloride of bismuth. After much coaxing she was only able to swallow half this amount. She was then placed standing before the X-ray apparatus. It was at once seen that the œsophagus was not distended, so that the obstruction could not be in it. A small shadow was seen just below the diaphragm, and from the right border of this a narrow streak of bismuth extended into a lower shadow, giving the characteristic appearance of hour-glass stomach, with an unusually small cardiac pouch. As the patient swallowed more bismuth the lower shadow gradually increased until it was much larger than the upper one. It extended from two inches below the umbilicus to a little below the symphysis pubis. The fluid took a long time to run away from the upper sac, so that the obstruction was evidently severe. The size of the pyloric pouch and the delay in the exit from the stomach made it clear that there must be pyloric obstruction as well. An operation was advised and the patient consented. The next day was spent in preparation. The patient was given nothing but sterilised milk and boiled water by the mouth, and rectal salines were administered every four hours. This improved the pulse and the general condition of the patient to a great extent. The false teeth were taken away and the mouth thoroughly cleansed several times a day with an antiseptic mouth-wash.

Operation. On the morning of the second day after the examination Dr. Page gave an anæsthetic, and the abdomen was opened through an incision made as high as possible in the left rectus muscle, some of the fibres of which were cut across in order to give more room. The stomach was explored and the conditions suggested by the X-rays were discovered. The upper pouch was very small, being about the size of a hen's egg. The lower pouch was fairly large, being about the size of a normal stomach. The pylorus was considerably narrowed, but fairly movable. The scar of a healed ulcer was seen upon its anterior surface. The constriction in the stomach was very hard and tight. There was not enough thickening of the wall to suggest carcinoma, nor were there any signs of any enlarged glands in the small or large omentum or pancreas. The stricture was 3 in. long and appeared to be due to the healing of a large saddle-shaped ulcer occupying the lesser curvature quite close to the œsophagus and exceeding far downwards upon both the anterior and posterior walls of the stomach. The lower part of the stomach was pulled downwards and to the right so as to bring the cardiac pouch into view. For reasons that will be presently discussed, a gastro-gastrostomy was decided upon. It was found to be imposssible to control the cardiac pouch with clamps without passing one blade through the gastro-colic omentum into the lesser sac of the peritoneum and upwards behind the stomach towards the œsophagus. The other blade was placed in front of the stomach and the lesser omentum, and the forceps were locked and closed. Another long clamp was applied on the anterior wall of the pyloric pouch near the greater curvature, and with its points directed upwards and to the left. The clamped portions of the stomach were then carefully isolated with moist packs, and they were joined together by two layers of direct sutures, just as in gastro-jejunostomy. Linen thread was the suture material used. The opening in the cardiac pouch extended from the lower and right border upwards, and to the left of and above the œsophageal orifice. This was the only way to make it long enough. The wall was extremely thick and hard. The mucous membrane was inflamed and closely adherent to the other coats, so that none of it could be removed separately. Therefore an ellipse of the whole thickness of the fibrous wall was removed. It was impossible for the through-and-through suture to pick up the mucous membrane all the way round without unduly narrowing the anastomotic opening ; but the other coats were so extremely fibroid that there did not appear to be any danger of the stitches cutting out. The external sero-muscular suture having been completed, tags of the lesser and gastro-colic omenta were fixed over the suture line. The pylorus was then brought into the wound, and an incision was made along its supple lower border and prolonged into the lower borders of the duodenum and stomach, which were close together. The wound was closed after Finney's method of gastro-duodenostomy, but with continued instead of interrupted sutures. Before the opening was made, clamps were applied to prevent leakage and hæmorrhage. The gall-bladder was found to be full of stones, but it was neither inflamed nor adherent, and the cystic duct was patent. There was no indication for removing the stones, especially as any prolongation of the operation would probably have resulted fatally. Moreover, the gall-stones had given rise to no symptoms for four years. When the operation was completed the stomach seemed to be about the normal size and shape. The new pylorus was very wide. The gastro-gastrostomy had drawn the pyloric pouch upwards and to the left. The abdomen was closed in layers, the operation being completed in forty-five minutes. A saline enema was given immediately on the return of the patient to bed. The patient was rather collapsed for the first two days. She was given water to drink from the first, and saline and nutrient enemata were administered alternately every four hours. The mouth was exceedingly dry and thirst was very severe. Towards the end of the second day milk was given by the mouth, and from that time onwards nutrients were discontinued. The food given by the mouth was gradually increased so that at the end of fifteen days she was on minced full diet. Gradually the patient became able to swallow larger amounts at a time. She left the home after five weeks with her condition very much improved, having gained over a stone in weight. By September 1910 she had gained 3 st. 10 lb. In 1912 she weighed 9 st., having more than doubled her weight. I removed gall-stones impacted in the common bile-duct and cystic ducts in February 1913, and the patient made a rapid recovery.

CASE 2. Mrs. A., aged 60, a patient of Dr. Colin King, Dr. Owen Lankester, and Dr. Hertz ; a housekeeper. The patient had suffered from indigestion for many years, and had vomited about once a day for the last fifteen years. She had had a great deal of abdominal pain, especially in the epigastrium. This was considerably relieved by vomiting. The bowels had been constipated for years, and she had

been in the habit of taking tabloids of cascara sagrada every other night. She never saw any blood in the vomit until ·about Christmas 1909. There was no history of melæna. Gradually the attacks of sickness have become much worse and more frequent, and the patient has been unable to do her work since Christmas 1910. At that time she brought up a large quantity of black vomit which was proved to be blood by Dr. Colin King. She has not seen any blood since. She has had to limit her diet more and more, and to mince her food. She was able to take chicken finely minced a fortnight ago. The patient has lost all her teeth except two for many years, but she uses artificial ones. For about two months she has been in the habit of having the stomach washed out about once every third day without getting much relief. She has been sleeping badly and has wasted a great deal, but she has not weighed herself.

Examination. Dr. Hertz on examining the stomach with the X-rays an hour after bismuth oxychloride had been taken with bread and milk, demonstrated a dark shadow above the costal margin and about three inches to the left of the navel. After about six hours a second pouch was seen towards the right iliac fossa, and a very narrow black streak connecting the two pouches, the upper of which had emptied somewhat. A diagnosis of hour-glass stomach was thus established (*see* Fig. 116). At
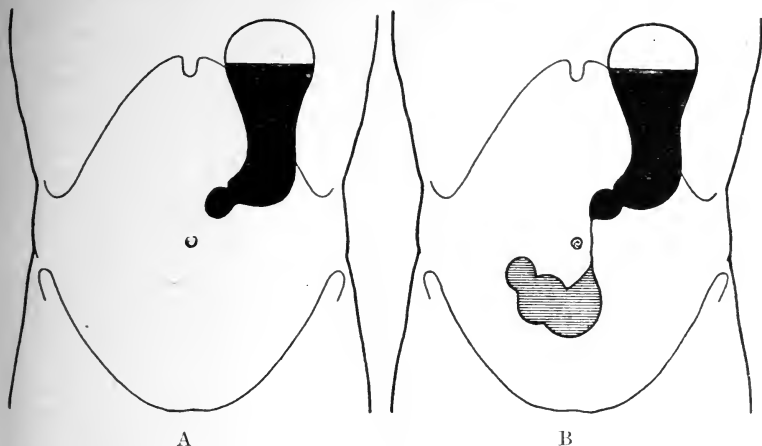
FIG. 116. Hour-glass contraction, Case 2, upon radiography with bismuth. A was taken an hour after a bismuth meal. B was taken six hours after the meal, when the lower sac became evident for the first time.

a second examination on June 28, after a tumblerful of milk containing bismuth oxychloride had been taken, the upper pouch was well seen, but not the lower one. After about half an hour, a nipple-like process appeared on the right border of the cardiac pouch, and this was thought to be the commencement of the narrow track leading to the second pouch. On further examination, no evidence of dilatation or hypertrophy of the pyloric pouch could be made out. An operation was advised, and the patient was taken into Dorset House for this to be performed.

During the four days that the patient was in the nursing home she was sick once or twice every night, bringing up a large quantity of sour fermented material. She could not sleep until vomiting had occurred in the early hours of the morning. She was able to take milk, fish, jelly, and beef-tea. The bowels were only opened once, in spite of several large doses of cascara sagrada and some white mixture. Saline enemata were given three times in twenty-four hours, and these were well retained. The stomach was washed out on the night of July 1, and again before the operation on the morning of July 2, half a pint of water being left in. The patient was sick in the night, in spite of the washing out. Her general appearance improved a good deal ; she became less shrivelled, and had less pain.

Operation. At 9 A.M. on July 2, Dr. Shipway giving the anæsthetic, the abdomen was opened through the upper part of the left rectus. The constriction was at once seen, and it was found to be adherent to a band stretching from it to the round ligament. The upper pouch was of a large size, the lower one being about a third the size of the upper. The upper pouch was very thick-walled and white, and showed

prominent muscular bands. The lower pouch was thin and natural. There was no contraction or ulceration of the pylorus or duodenum, and the gall-bladder was also healthy. Above the constriction a funnel-shaped ulcer could be felt. It was thick-walled, and was hard. No enlarged glands could be felt in the lesser omentum, the gastro-colic ligament, or about the head of the pancreas. The ulcer was fairly movable posteriorly. The band already mentioned was ligatured and divided, and very large pouches of the cardiac and pyloric parts of the stomach were emptied and clamped. The points of the clamps were 1 inch below the constriction and their bases on the greater curvature, 5 inches on either side of the constriction. A gastro-gastrostomy was performed in the usual way, except that two layers of perforating sutures were used posteriorly instead of one. The opening was $3\frac{1}{2}$ inches long. The stricture was extremely tight, the external circumference just beyond the ulcer being no thicker than an ordinary lead pencil, so that it was difficult to imagine anything getting through. Fine-linen thread was the suture material used. The abdomen was closed in layers in the usual way. The operation lasted three-quarters of an hour. The patient was not shocked when she was put back to bed. She was given $\frac{1}{4}$ grain of morphine, and 1 pint saline enema. During the next twenty-four hours the patient vomited several times, bringing up small quantities of brown material. The stomach was therefore washed out, and this immediately relieved the vomiting. Afterwards the patient made an uninterrupted recovery, and was last heard of in March 1913, when she was quite well—in fact, better than she had been for over twenty years. Some months after the gastric operation acute appendicitis developed and the appendix was at once removed.

Results of Operations for Hour-glass Stomach. The following Table has been compiled by Deaver and Ashhurst from Veyrassat's statistics.[1] Both the immediate and remote results compare very unfavourably with those obtained at the present time. My experience is that both the immediate and remote results, both of gastro-gastrostomy and gastro-jejunostomy, are exceedingly good.

Operation.	Cases.	R.	D.	Mortality per cent.	Cured per cent.	Failed per cent.
Gastro-gastrostomy	22	18	4	18	68	13·6
Gastro-plasty	48	43	5	10·4	75	14·6
Gastro-jejunostomy	73	59	14[2]	19·1	78	2·73
Cylindrical gastrectomy	12	11	1	8·3	91·6	—
Resection	3	1	2	66·6	—	—
Partial gastrectomy	2	2	—	—	100	—

[1] *Revue de Chir.*, August, September, December, 1908.
[2] Six deaths due to anastomosis with pyloric instead of cardiac pouch.

CHAPTER XIV

PARTIAL GASTRECTOMY. TOTAL GASTRECTOMY

PARTIAL GASTRECTOMY

IN this operation a large but variable part of the stomach is removed. For growth the pylorus, an inch of the duodenum, and the greater part of the stomach are removed, so that the channel can be re-established only by gastro-jejunostomy engaging the cardiac remainder. For simple ulceration a smaller portion usually needs removal, so that it is sometimes possible to re-establish the channel either by end-to-end union or posterior gastro-duodenostomy after Kocher's method. With a great reduction in its mortality the operation is more and more frequently performed both for malignant and innocent ulcerations. For carcinoma, although it may not always eradicate the disease, it offers both a greater prolongation of life and greater relief than gastro-jejunostomy, without seriously increasing the immediate risk. It is often difficult to be sure that a chronic ulcer is innocent, and for this reason resection should be performed whenever practicable without greatly adding to the risk. Moreover, a callous ulcer may become malignant in spite of gastro-jejunostomy.

Indications. (i) Malignant disease of the stomach, especially of the pyloric segment. This is nearly always carcinomatous, but sarcoma is not so uncommon as it is generally supposed to be.[1] The writer has performed partial gastrectomy in one case.

(ii) Some cases of chronic ulceration of the pyloric region, especially when malignant disease is feared.

(iii) Some cases of hour-glass contraction with ulceration at the stricture. When the pyloric pouch is of good size, the pyloric and cardiac remainders may be joined end to end.

(i) **Malignant Disease.** This is the most important indication for resection, and it calls for special attention here. It is significant and fortunate that in the large majority carcinoma, like simple ulcer of the stomach, starts at or near the pylorus upon the lesser curvature. Significant because of the undoubted risk of a chronic ulcer becoming malignant. Fortunate because a growth in this situation—

(a) Soon leads to obstructive signs of great value in diagnosis,

(b) The growth is often palpable in the epigastrium, and

(c) Is favourably placed for resection if the diagnosis is made in time.

In a few cases carcinoma commences at the cardia or in the fundus, where radical operation is rarely practicable. Growths upon the anterior or posterior walls near the middle of the stomach are more amenable

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[1] Gosset has collected 171 cases, with 13 gastrectomies and 10 deaths. Metastases are much less common than with carcinoma (*Ann. of Surg.*, 1911, vol. ii, p. 313).

if they are discovered in time, but this is unusual, for they do not cause obstruction or early symptoms.

Without operation cancer of the stomach is absolutely hopeless. Spontaneous cure is not known, and medicine is of no use except to alleviate the symptoms of inoperable disease. Surely surgery can do better than this if given a chance, but too often the surgeon is not asked to see the patient until the diagnosis is obvious and the prognosis hopeless.

Diagnosis. Much time is wasted on laborious attempts to arrive at a diagnosis from various laboratory tests. This " scientific and deadly delay " (Mayo) often throws away the opportunity of radical and successful operation. The laboratory tests must be regarded as nothing more than aids in the diagnosis. For instance, free HCl, although usually diminished, may be found even in excess with early gastric carcinoma. It may be greatly reduced in pernicious anæmia, chronic pancreatitis, or hour-glass stomach. Blood-corpuscles may be absent. Apart from obstruction, X-ray examinations are not of great value in early cases. Gastroscopy is not yet reliable in excluding carcinoma, and the same is true of examinations of blood serum. Cancer of the stomach in its early stages does not give rise to symptoms which can be said to be characteristic of the disease. Rapid and progressive wasting, anæmia, pain, anorexia, nausea, and vomiting are suggestive. These, and especially a palpable tumour or obstructive signs, however, indicate an early exploration. Some half-cooked rice and a few raisins are given with some soup in the evening. If on washing out the stomach in the morning any food remnants are found there is clearly obstruction, and although this may be due to a simple ulcer, it strongly indicates an operation both for diagnosis and treatment. *It cannot be too strongly urged that diagnosis to be early enough must frequently be made by exploration.* Operation is delayed because the *immediate mortality* is generally supposed to be very high, and the *prospect of permanent cure or prolonged relief is believed to be poor.*

As regards the **immediate mortality** the technique of partial gastrectomy has been so much improved in recent years that in the last hundred cases operated upon at St. Mary's Hospital (Rochester) there was a mortality of 7 per cent., in the last fifty 4 per cent., " nor are these figures exceptional " (Mayo).[1]

As regards **ultimate results,** out of ninety patients who have been traced for over three years after operation, 36·6 per cent. are alive ; out of fifty-eight traced over five years after operation, thirteen or 22 per cent. are known to be alive and well. " These data would indicate that the patient with cancer of the stomach, which is sufficiently localised to be removed radically, has better than a 90 per cent. chance to recover from the operation, and better than a 36 per cent. chance of a three years cure, and at least a 25 per cent. chance of a five years cure."

As it is, less than a third of the cases of carcinoma of the stomach are diagnosed early enough to allow a radical operation. *Without exploration, how are we to tell if a case is inoperable ?* This is not possible in many cases, as shown by the following Table :

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[1] *Surg. Gyn. and Obst.,* February 1912.

Cases of Cancer of the Stomach examined in the Mayo Clinic between January 1, 1908, *and September* 1909

Total number	335
Hopeless and not admitted	146
Resection	78
Gastro-jejunostomy	39
Excision of malignant ulcer	2
Exploration. Inoperable disease found	70

The following **clinical signs** indicate that the growth is inoperable, and that it is inadvisable to submit the patient to an exploration :

(i) The discovery of dropped and grafted nodules of growth in the pelvis on rectal or vaginal examination.

(ii) Enlarged supra-clavicular glands, especially common on the left side.

(iii) Nodules of growth at the umbilicus or under the skin of the abdomen.

(iv) Ascites, indicating peritoneal growth or obstruction of the portal vein.

(v) Nodular enlargement of the liver.

Moreover, the patient may be too exhausted to stand the operation.

Upon exploration the following points indicate that the growth is unsuitable for resection :

(i) *Secondary Growths in the Viscera*, especially in the liver. The hand is always passed above as well as below both lobes of the liver, for it is not uncommon to find isolated nodules of growth upon the diaphragmatic surface of the liver. A direct local invasion of the anterior edge of the liver is not always a contra-indication, for a wedge-shaped piece may be resected with the primary growth. More often an invaded gall-bladder or even the transverse colon may be removed without detriment. Invasion of the pancreas has been usually regarded as a strong contra-indication, but recent work has shown that portions of the pancreas may be safely removed.

(ii) *Peritoneal Infection.* The hand is passed into the pelvis, and the small intestine is inspected. If nodules of growth are discovered it is generally useless to attempt resection of the primary growth, but an isolated nodule in the pelvis need not necessarily interfere, for it may be either removable or of slow growth, so that prolonged *relief* may be expected from resection.

(iii) *The Size, Site, and Degree of Fixation of the Growth.* While in many cases cancer of the pylorus may remain long limited to the pylorus itself, it is very liable to infect the omenta and the lymphatic glands around the head of the pancreas, and later to cause secondary growths in the liver and other parts.[1] Adhesions, too, are very frequently met with between the stomach and the colon, pancreas, and liver.

When adhesions are present the immediate mortality of the operation is greatly increased, and this is especially true of adhesions involving the pancreas. The prospects of permanent relief are, of course, much diminished, for the growth follows closely in the wake of inflammatory adhesions. *The more the growth has extended towards the cardiac orifice along the lesser curvature, the less the chance of successful resection.*

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[1] McArdle (*Dublin Journ. Med. Sci.*, vol. lxxxiii, p. 511), having collected from the statistics of different writers 1342 cases, states that the pylorus alone was involved in 802, or over half the cases.

Moderate enlargement of the lymphatic glands is not a contra-indication to resection, for the glands are very frequently found to be merely inflammatory, and they may be seen near a simple ulcer.

When the glands are of large size and adherent or widespread, it is generally too late to attempt the removal of the growth. In the great majority of cases, an exploration should be undertaken before any tumour can be felt, but it is certainly not true that resection may be considered to be impracticable because a tumour is evident, for even the induration around a simple pyloric ulcer may be felt in thin patients. It must not be concluded from the apparent mobility of a growth felt through the abdominal wall that a resection is practicable, or *vice versa*.

From a careful consideration of the symptoms, and the results of chemical and microscopical examinations of the gastric findings, &c., the diagnosis should be more frequently made before the growth becomes irremovable ; and with this object an early exploration should be undertaken, when the symptoms do not yield to treatment and suggest the probability of the existence of carcinoma of the stomach. The danger of an early exploration is very small, although a simple exploration in late and inoperable cases carries with it a considerable risk, as shown by the experience of Kronlein and Mikulicz, who had a mortality of about 9 per cent. in such late explorations.

The researches of Cuneo, MacCarty, Boormann, and others have taught us much about the ways in which carcinoma of the stomach spreads. This information is of great value in telling us when and how to attempt resection. It is fortunate that—

(a) *Dissemination into the Liver and other Viscera* is a late event.

(b) *Lymphatic Infection.* A great deal depends upon the lymphatic drainage of the stomach and of the cancer-bearing area, which in 80 per cent. of the cases is to the right of a line continued downwards from the right border of the œsophagus (*see* Fig. 117). The lymphatics drain into the glands in the gastro-hepatic and gastro-colic omenta. The glands in the lesser omentum are fairly numerous, and consist chiefly of two groups, one about the coronary artery, and another just above the pylorus. Those in the gastro-colic ligament are all to the right of the line already mentioned, and they are especially numerous just below the pylorus. The lymphatic current is chiefly towards the right, and soon carries the infection to the group of glands lying near the head of the pancreas to the right of the cœliac axis. There is very little tendency for the disease to spread along the greater curvature towards the left into the fundus, which can be safely left in pyloric and prepyloric growths which form the large majority of gastric cancers. Along the lesser curvature there is a great tendency for the disease to spread to the left both in the stomach-wall and in the lymphatics. In some cases the primary lymphatic glands escape, while the secondary ones are invaded. Occasionally there is an erratic spread so that the glands in the transverse mesocolon may be invaded early. Infected glands vary much in size, and without microscopic examination it is impossible to be sure whether a gland is or is not invaded. The only safe way is to remove all the draining lymphatic glands. In view of the occasional infection of the great omentum it is also wise to remove it as well as the lesser omentum. The degree of lymphatic infection varies very much, and does not seem to have any very distinct relation to the position or size

of the primary growth. Both the immediate risk and the ultimate prognosis depend very much upon the degree of lymphatic infection.

(c) *Local Spread.* The disease spreads by permeation of the lymphatics of the stomach, especially those in the submucosa, and especially
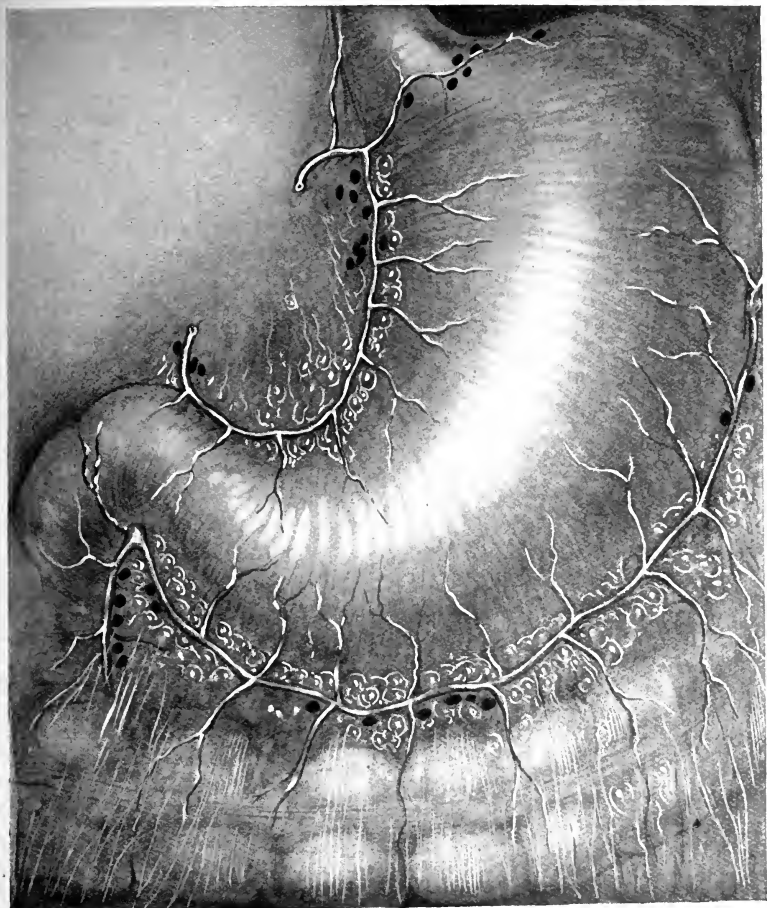
Fig. 117. The lymphatic drainage of the stomach. The greater number of glands are along the lesser curvature, and below and behind the pyloric portion.

along the lesser curvature towards the cardiac orifice. The growth often seems to end abruptly at the pylorus, but microscopic examination has shown that permeation extends a little beyond this into the duodenum, so that it is always wise to remove at least an inch of the duodenum.

(d) *Peritoneal Infection.* Nodules of growth are commonly found in the peritoneum, especially at the bottom of the pelvis, and later upon the peritoneal covering of the small intestines. This is due to the direct infection by cancer-cells which have escaped into the peritoneal cavity and gravitated towards the pelvis.

Therefore it is clear that resection to be ultimately successful must

be wider than hitherto, both as regards the stomach and the lymphatic vessels and glands. The immediate mortality does not seem to have increased with the amount of stomach resected, nor is the mortality of a well-planned resection in late cases much greater than that of gastro-jejunostomy, whereas the amount of relief and extension of life obtained is very much greater in resection. Usually the average relief after gastro-jejunostomy for growth is only about four months, and this relief is often incomplete owing to the presence of the ulcerating and decomposing growth.

The more frequent excision of callous gastric ulcers will do much to prevent the development of cancer of the stomach, and many a developed but unsuspected cancer will be removed at an early and hopeful stage. The ideal is to operate at an early stage before the growth has become adherent to vital parts and before the lymphatic glands have become invaded. Both the immediate and ultimate results of the operation will rapidly improve as this ideal is approached.

Operation. A free incision is made in the middle line extending from the epigastric angle downwards a little below the umbilicus. A thorough exploration is rapidly carried out to determine if an attempt at resection should be undertaken. Then the large vessels are at once ligatured to limit hæmorrhage and shock (*see* Fig. 118). This step also makes the operation much easier and saves valuable time. The lesser omentum is opened in a bloodless part close to the liver, and the pyloric artery is divided between two ligatures tied well above the pylorus and the group of lymphatic glands in this situation. The common bile-duct and hepatic artery are carefully avoided, as they lie on the portal vein in front of the foramen of Winslow. Adhesions between the liver and the growth may have to be separated to allow this step to be carried out. The upper border of the pylorus and duodenum are cleared for two inches, and any vessels that bleed are at once tied. The stomach is drawn downwards and to the right, while the gastric artery is carefully tied and divided near the cardiac orifice, and the lesser omentum is separated from the lesser curvature for about an inch and a half. The lower border of the stomach is then examined, and the left gastro-epiploic is divided between two ligatures at the selected point, which is well to the left of the lymphatic glands in the gastro-colic omentum and also to the left of a line continued downwards from the right border of the œsophagus. The lower border of the stomach is cleared for about two inches. The great omentum is then carefully separated from the transverse colon, and any bleeding points are at once tied (*see* Fig. 119). This step is usually easy, but it may be more difficult when inflammatory adhesions exist around a large growth. Several ligatures are generally required at the upper and left attachment of the omentum. The stomach and omentum are then separated from the transverse colon and mesocolon, great care being taken to avoid injury of the mesocolic vessels. The bloodless area of the transverse mesocolon, if adherent to the stomach, should be removed with it, and the opening thus made may be used for the gastro-jejunostomy later on. The mesocolic artery is carefully traced to its origin below the pancreas, and any glands upon it are removed by gauze dissection. An injury or obliteration of this artery may cause gangrene of the transverse colon, although the anastomoses between its branches and the right and left colic arteries usually preserve the circulation of the bowel. Such an injury can

usually be avoided by care and gauze dissection. The great omentum and pyloric pouch are drawn up and the glands lying below the pylorus are very carefully separated from the pancreas, and the right gastro-epiploic artery is tied and divided near its origin. Sometimes the
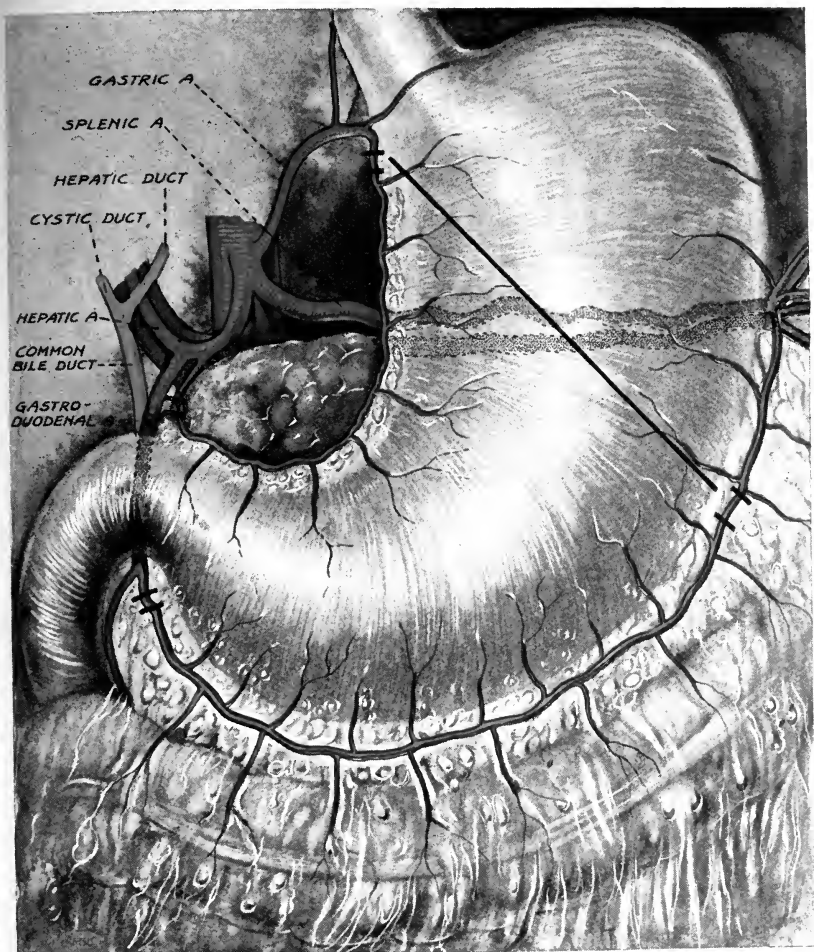
FIG. 118. The arteries of the stomach. Preliminary ligation of the gastric, pyloric, the right and left gastro-epiploic vessels is of the greatest importance in gastrectomy.

gastro-duodenal has to be tied when the lymphatic glands are large and adhesions numerous. Great care is required in separating the pylorus, the first part of the duodenum, and the pancreas, and in some cases this step has to be deferred until a later stage of the operation after the duodenum has been divided, when a better view can be obtained, and some of the adherent pancreatic tissue can be shaved off and removed with the growth. The raw surface thus left is covered by suturing the posterior peritoneum over it. The lower border of the duodenum is cleared for about two inches. The primary growth, the chief draining

lymphatic glands, and the omenta have been isolated in one mass, and the important vessels have been tied.   Packs are now carefully placed behind and around the stomach.   The duodenum is divided between two clamps one inch to the right of the pylorus and the cut edges are
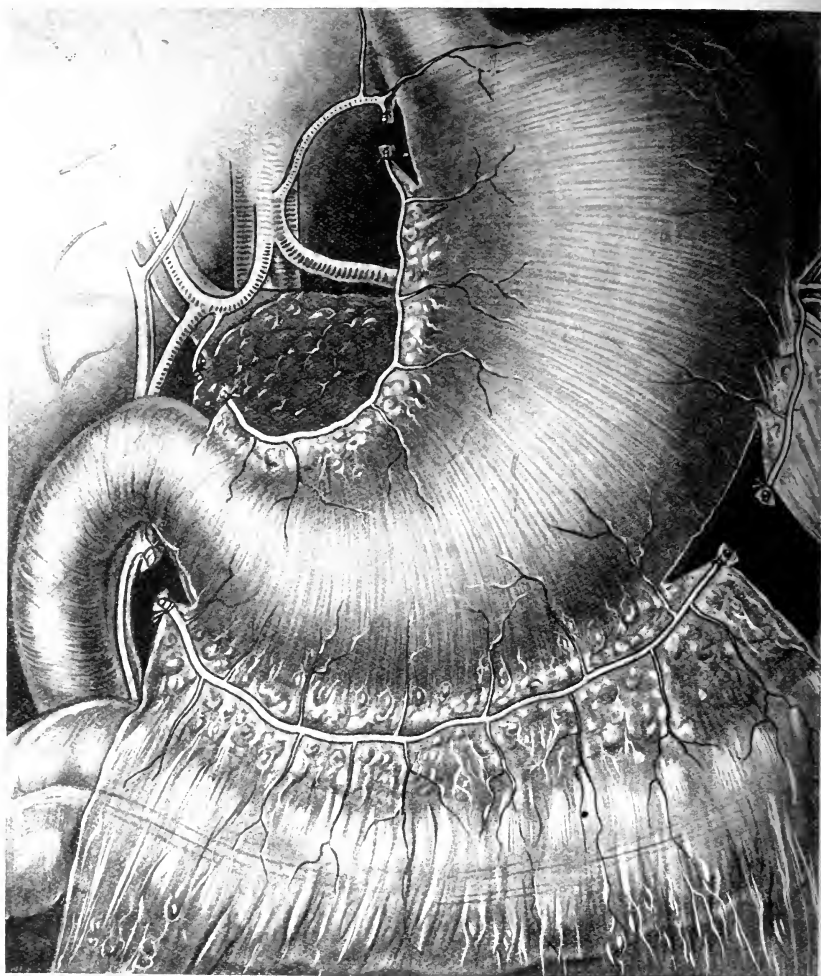
F1G. 119.   Partial gastrectomy.   The coronary and pyloric vessels have been tied and the lesser omentum divided, and the right and left gastro-epiploic vessels have also been tied and divided.   The borders of the stomach have been cleared ready for the clamps.

cauterised (see Fig. 120).   The pyloric end of the stomach is drawn out of the way, turned over to the left, and protected while the duodenal stump is closed with a continuous catgut suture starting at the upper border and passed around the blades of the clamp until the lower border is reached, when the clamp is removed, the suture drawn tight, and its ends tied together.   The suture controls all bleeding and puckers the stump. Two purse-string sutures of linen thread are then used to invaginate

the stump (see Fig. 121). The final one picks up some of the pancreatic sheath, and thus serves to turn the end of the stump backwards and bury it in the pancreatic tissue. Some of the posterior parietal peritoneum may also be brought over the end. All bleeding from the region of the

Fig. 120. Partial gastrectomy. Clamps applied and the duodenum divided. The duodenal stump is sewn over the blades of the clamp holding it. As the clamp is withdrawn the suture is tied. A purse-string suture is also shown.

pancreas is carefully stopped and the stomach is drawn well downwards and to the right. Now two powerful and long gastrectomy clamps are applied extending from the cleared area of the lower border of the stomach to the similar area of the cardiac orifice. There is always some difficulty in satisfactorily applying the left of the two clamps, removing enough of the lesser curvature and yet leaving enough margin of stomach for accurate suturing just below the œsophagus. Mayo gets over this difficulty by applying an additional bayonet-shaped clamp from above downwards to the left of the other clamps. The stomach is then divided between the two long clamps and the growth together

with the omenta are thus removed in one piece. The opening in the cardiac remainder is then closed by three layers of sutures. The first is a continuous suture of strong catgut applied after Connell's method and starting at the lower border. As the upper border is approached,
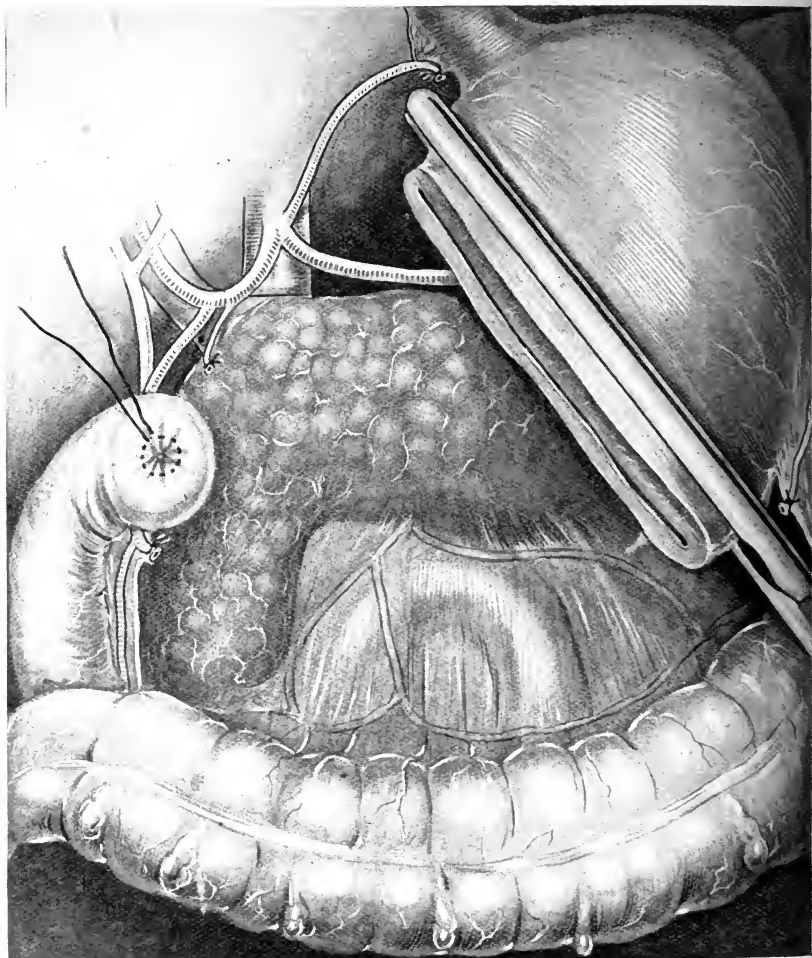
FIG. 121. Partial gastrectomy. The growth has been removed and the duodenal stump is closed by a purse-string suture supplementing the deep perforating suture. The transverse mesocolon and its vessels are shown undamaged.

if the clamp slips and the projecting lips become too short, the suture is passed round the clamp, and drawn tight when the latter is removed. To avoid hæmorrhage, the suture is drawn and held tight throughout. The suture line is then invaginated by two continuous serous sutures of fine linen thread. Posterior gastro-jejunostomy is then performed (see Fig. 122). Sometimes this is very difficult owing to the small size and high position of the cardiac remainder. To avoid this difficulty Moynihan performs the gastro-jejunostomy before dividing the stomach

so that he can use the left part of the stomach as a tractor to draw down the cardiac portion for the anastomosis. When the cardiac remainder is very small, anterior gastro-jejunostomy is performed and serves well. In making this anastomosis the opening must not be
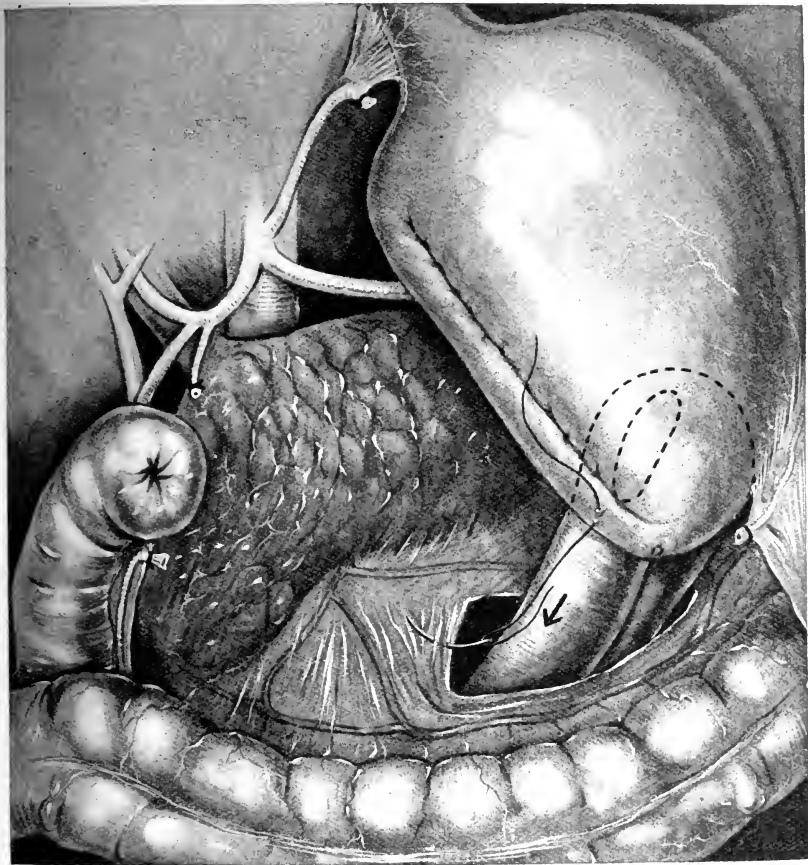
Fig. 122. Partial gastrectomy. The cardiac pouch closed and posterior gastro-jejunostomy performed. The opening in the mesocolon is being closed.

made too near the sutured and rigid right border of the cardiac pouch. As a rule the writer prefers to join the jejunum directly to the open end of the cardiac pouch as shown in Fig. 123. This saves much time and is less likely to be followed by necrosis and temporary gastric fistula. End-to-end union is rarely suitable when the resection is made for growth, for in spite of mobilisation of the duodenum after Kocher's method there would be too much tension upon the suture line. In some cases of pylorectomy for callous simple ulcer, the open end of the duodenum may be joined to the posterior surface, but not to the much larger cut surface of the stomach. The disparity in the size of the two openings nearly always leads to imperfect suturing and leakage at the " dangerous angle." It is quite a different thing to make an end-to-end union after resection of early malignant growth or a callous

ulcer occupying the middle of the stomach. Then two ends of similar size can be joined well and safely together. Some surgeons advocate the performance of gastro-jejunostomy immediately before the resection, and if the patient is not doing well at the end of the gastro-jejunostomy,
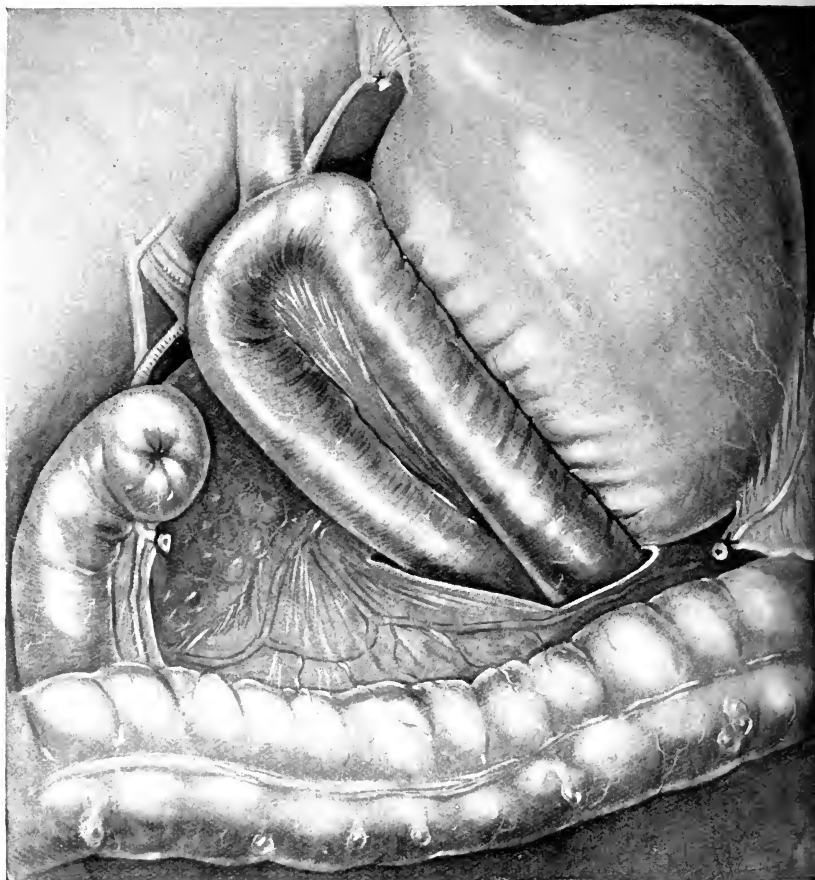
Fig. 123. Partial gastrectomy. The jejunum has been joined directly to the open end of the cardiac pouch. This saves much time and lessens the risk of leakage.

the resection can be deferred until another day. Moreover, a doubtful growth can be microscopically examined during the gastro-jejunostomy. I do not like this method because a preliminary gastro-jejunostomy may interfere with a proper resection, and the retraction of the cardiac portion of the stomach which follows the resection may drag upon and kink the jejunum. Deaths have occurred from this cause. It is better first to perform a wide resection and then to make the gastro-jejunostomy suitable to the occasion. The primary examination of doubtful tumours is not as yet thoroughly reliable. Moreover a large callous ulcer closely simulating growth is better resected. As regards a two-stage operation, the combined risk of the two operations is greater than that of immediate resection, and, further, the patient, if he recovers

after gastro-jejunostomy, is often so pleased with his condition that he fails to see the advantages of another operation until it is too late.

Illustrative Case. Gastric Carcinoma ; Partial Gastrectomy

J. W., aged 51. Gastric symptoms for four months : vomiting, anorexia, indigestion, constipation, chronic hæmatemesis and melæna, very severe anæmia and wasting ; lost twenty-two pounds in fifteen days.

Operation November 1909 : The writer performed extensive but not complete gastrectomy ; draining glands and omenta removed ; duodenum closed ; gastro-jejunostomy. Microscopical section shows carcinoma.

Patient now, three and a half years after the operation, quite well and doing his ordinary work as a lift conductor. He has gained over three stone in weight. At first he could only take small meals ; very small remainder of stomach has considerably dilated, as shown by the X-rays.

TOTAL GASTRECTOMY

It is very rarely necessary to remove the whole stomach, for when malignant disease is so extensive as to invade the whole stomach it is usually incurable for other reasons, such as extensive adhesions or secondary growths. The technical difficulties are so great as compared with those of sub-total gastrectomy that it is desirable whenever possible to save even a small healthy portion of the cardia. This makes the anastomosis very much easier. The chief indication for the operation is that variety of chronic diffuse carcinoma of the stomach which produces a small leather-bottle stomach, the " linitis plastica " of Brinton. Fortunately secondary growths (and extensive glandular infection) are rarely associated with this condition.

It is possible that the operation may be required for an inflammatory leather-bottle stomach. It is unfortunate that a sharp distinction is not being drawn between complete and nearly complete removal of the stomach, and even when a small portion is left the operation should be called partial gastrectomy.

Conner, of Cincinnati, was the first to perform this heroic operation in 1883, but his courage was not rewarded, for the patient died upon the table.

Schlatter, of Zurich, was the first to perform the operation successfully, in 1897.

Paterson[1] " collected twenty-seven cases of total gastrectomy for malignant disease. Of the twenty-seven patients ten died and seventeen recovered, a result surprisingly good considering the extent and severity of the operation."

Mr. Paterson ascertained the subsequent history of all except two of the seventeen patients who survived the operation. Five of the patients had died, but the average duration of their lives after the operation was nineteen months. " Dr. Brookes Brigham's patient was in perfect health eight years after the operation. Dr. Macdonald's patient was alive and at work as a farm labourer, although seven years had gone by since his operation."

Six of the patients were living and well six years after the operation, and three were well five years after it.

As regards the method of operating, the best plan is the one adopted and so well described by Sir Berkeley Moynihan.[2] His patient was a

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[1] Hunterian Lectures, 1906.   [2] *Lancet*, 1907, vol. ii, p. 1748.

man, aged 43, with malignant leather-bottle stomach. I venture to quote his description of the operation.

(1) *Operation.* The abdomen was opened in the middle line by an incision which at first was about three inches in length, sufficient to allow of exploration, but which was increased subsequently to a length of eight inches. At the outset there was a very serious difficulty in exposing the stomach. The patient was a man who had been stout, but who had lost weight rapidly ; the anterior abdominal wall therefore shelved downwards from the elevated costal margin in such manner, as to make the upper part of the stomach appear to be at great depth from the surface. The patient, moreover, was not at all comfortable under the anæsthetic, and I had to wait a long time after opening the abdomen before I could proceed with the operation.

When the stomach was exposed it was seen to be small in size with walls of great thickness and solidity. The whole organ, indeed, felt solid, resembling a very large uterus, having thick walls and an insignificant cavity within it. (This is well shown in the skiagraph subsequently taken.) The surface was smooth, white, and opaque ; there were no adhesions and but few obviously enlarged glands along the curvatures. Towards the cardiac end the stomach was larger than elsewhere, so that the organ had something of the shape of a Florence flask ; the larger part, however, was still very much smaller than the normal. This being the condition of the stomach it was at once evident that the performance of gastro-enterostomy was impossible, for there was no sufficient cavity in the stomach to admit of any anastomosis being made. The alternative procedures were complete gastrectomy and either jeju-nostomy or duodenostomy ; after some deliberation I decided in favour of the former and I proceeded at once to remove the whole stomach. It was at this point that the abdominal incision was enlarged. Hot moist swabs in two layers were then packed into the abdomen in the usual manner to isolate the field of operation. The stomach was now depressed as far as possible by forcible traction by an assistant and two long clips were applied to the coronary artery at its origin from the cœliac axis. The artery was divided between the clips, and its proximal end was ligatured. The upper and lower coronary groups of glands were detached downwards towards the stomach by gauze stripping, and the cardiac end of the stomach was denuded by the same means. The gastro-hepatic omentum was divided after ligature as close up to the liver as possible until the upper border of the pylorus was reached Here, by gauze stripping the pyloric artery and the gastro-duodenal artery were exposed as they separately arose from the main hepatic trunk. The pyloric artery was ligatured and divided, and the finger was then passed downwards behind the pylorus and made to present at the lower border of the duodenum, where an opening was made in the great omentum. Through this opening the blade of a clamp was passed upwards behind the duodenum to present above the pylorus. When the clamp was closed it lay about one inch beyond the pylorus, and on the stomach side of it there lay the sub-pyloric group of glands. A second clamp with rubber-covered blades was now applied distal to it, and the duodenum was cut between them. A single strong catgut suture was then passed through the proximal part of the duode-num and round the clamp to prevent the clamp from slipping away. The distal end of the duodenum was then closed by a continuous catgut suture, taking all the coats, and by a double layer of Pagenstecker thread suture above this. The clamp holding the proximal part of the duodenum was now covered with a gauze swab and was lifted well towards the left, exposing the gastro-duodenal artery more conspicuously. The artery was ligatured and divided. Along the whole length of the greater curvature the gastro-hepatic omentum was divided at a distance from the stomach of from one to two inches, so that all glands, including one or two dropped glands, were left attached to the stomach. The whole stomach was now free, for the gastro-hepatic omentum had been entirely divided, the duodenum was severed, and the gastro-colic omentum ligatured and cut free. The whole stomach hung pendulous from the œsophagus. At this point the anæsthetist was asked to flex the patient's neck as much as possible, in the hope that this might enable the œsophagus to be pulled downwards a little more readily, and it seemed that this hope was fulfilled. The œsophagus was dragged upon with a fair degree of force until at least three-quarters of an inch of it was visible below the diaphragm.

The next step, and the most important and difficult of all, was the anastomosis of the œsophagus to the jejunum. The transverse mesocolon was already exposed on its upper surface in the wound ; it was divided in an avascular area and the upper loop of the jejunum pulled through it. A point on this about eight inches from the duodeno-jejunal flexure was selected for the anastomosis. A piece of it

about two and a half inches in length was laid transversely along a line immediately behind the œsophagus. As it lay there transversely, the right leaf posterior, its upper end was to the left, its lower to the right. The anastomosis was now begun by introducing eight light interrupted sutures between this portion of the jejunum and the œsophagus. The part of the circumference of the jejunum used was that on the surface which was now posterior, and on this surface about three-quarters of an inch from the mesenteric attachment. As the sutures were introduced into the œsophagus this was made to present and was well exposed by a forcible and

FIG. 124. Complete Gastrectomy. The stomach is used as a tractor to bring the œsophagus down for suture to the jejunum. The œsophagus is gradually divided, and a few turns of the deep suture are added after each snick with the scissors.

continuous downward traction upon the stomach. The stomach, wrapped in a hot gauze swab, was used, and most efficiently used, as a retractor, or rather as an instrument of traction, upon the slightly dilated œsophagus. The help derived from this manœuvre was far greater than could be believed from a mere description. It converted what would have been an excessively difficult feat into one of comparatively easy accomplishment. Eight interrupted sutures then were introduced until the whole of the posterior half of the œsophagus was securely attached to the jejunum. In front of these a continuous suture was now introduced, exactly as in the operation of gastro-enterostomy from left to right ; the needle carrying this suture was then laid aside to be presently resumed. The attachment of the œsophagus to the jejunum seemed now quite secure on this posterior aspect. In front of this continuous suture a small opening was made into the œsophagus, and into the jejunum at the extreme left

end of this attachment. A continuous through-and-through fine linen thread suture was now begun and a few turns of the needle taken until the whole length of the small openings made had been united (*see* Fig. 124). These openings were then enlarged little by little from left to right, and as they were enlarged their cut edges were sutured by the same continuous stitch. This sequence of a small incision, a few stitches, slight enlargement of the incision, a few more stitches, was continued until the whole of the posterior part of the œsophagus was divided and sutured to the incision in the jejunum. Around the anterior wall of the œsophagus the same sequence was continued. the stitch being now changed to the " loop on the mucosa " form. The result was that the stomach was retained as a tractor, drawing down the œsophagus until the last piece was severed, and at that moment the line of anastomosis was almost complete. Finally the outer continuous suture previously laid aside was resumed and continued round the anterior surface of the œsophagus and jejunum to its starting-point, where it was tied and cut short. The suture line was now complete. There were, it will be seen, eight interrupted posterior sutures, intended as anchor sutures. and the two continuous sutures, as in the usual operation of gastro-enterostomy. A few anterior anchor sutures fixing the jejunum and the œsophagus to the diaphragm were now taken and the main part of the operation was now complete. The great omentum was turned upwards over the operation area and the abdomen closed.

The patient had borne the operation well. There had been no soiling of the operation field nor any exposure of viscera. As soon as the patient was put back to bed the continuous administration of saline fluid by the rectum was commenced. In the first twenty-four hours nine pints were taken ; in the second twenty-four hours six pints. After this it was discontinued. The help given by the absorption of fifteen pints of normal saline solution within forty-eight hours is probably difficult to exaggerate. During this time, contrary to my usual practice. I gave no fluid by the mouth, but the patient was allowed to flush his mouth as often as he wished. He never complained of thirst and did not suffer any great amount of pain. He was kept lying flat on his back, with the head propped well forward. The administration of fluids by the mouth was begun very cautiously on the third day. Two teaspoonfuls of water were given every half-hour ; on the fourth day this quantity was increased to two ounces every half-hour. On the fifth day five ounces were given hourly ; water and peptonised milk and albumen water were given in succession. On the sixth day two pints of these fluids were taken while the day nurse was on duty and one pint six ounces during the night. These quantities of the same fluids were slowly increased until on the tenth day five pints were taken in the twenty-four hours. On the eleventh day beef-tea and Benger's food were given, on the fourteenth day milk pudding, and on the eighteenth day bread and butter. During the third week the patient told us every day that he was hungry, a sensation which he had not experienced so keenly for two years. At the end of the third week he began to take meals of fair quantity consisting of minced chicken, milk puddings, &c. He was kept in bed for eighteen days, and on the twenty-second day was sent to a convalescent hospital. On leaving the hospital his weight was 8 st. 12 lb., a gain of 10 lb. On August 21 he weighed 10 st., and was able to eat all foods.

This is the second occasion upon which I have been called upon to perform complete gastrectomy.[1] The circumstances present in the two cases were similar ; the stomach was small, with thickened walls and a cavity greatly reduced in size ; it was invaded in every part by cancer, the glands were only slightly affected, there were few adhesions, no invasion of the parts around by the growth, and no secondary deposits. It has been computed by Fenwick[2] that 14 per cent. of all patients dying from carcinoma of the stomach show no extension of the disease beyond the stomach. The type of cancer in both these patients was atrophic, and the malignancy was probably of a low grade. It would seem that conditions of the kind enumerated are essential to the successful carrying out of the operation of complete gastrectomy. In my first case, which proved fatal, I adopted a technique which I thought satisfactory. After the operation I gave much thought to the details of the operation and endeavoured to construct a method which I should carry out if the opportunity again came to me. I had determined to make use of the stomach-tube passed through the œsophagus into the jejunum as a sort of cylinder upon which to suture, and I considered that the fixation (by a catgut suture) of the tube

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[1] *Brit. Med. Journ.*, 1903, vol. ii, p. 1498.
[2] *Cancer of Stomach*, p. 54.

to the cut end of both œsophagus and jejunum (the suture being, of course, buried by the continuous sutures along the line of anastomosis) would help to make the feeding of the patient during the time of healing of the wound a simple and a safe matter. But when I came to perform this second operation I realised as I saw the stomach pendulous from the œsophagus that it might be used with the very greatest advantage to hold the œsophagus in a fixed position until my suture lines were practically complete. I feel sure that this point is one which has solved the greatest of all difficulties in the operation of complete gastrectomy, and it embodies, moreover, a technical principle which is applicable to other operations than this.

This patient gained 2 st. 10 lb. in weight, and made a good recovery. His appetite was good, and he was able to eat ordinary foods, but he had to take rather a long time over his meals. He remained perfectly well nearly three years, then he gradually developed a profound anæmia, from which he died, three years and eight months after the operation. At the autopsy [1] there was " complete absence of any recurrence or dissemination." The upper part of the jejunum was a little dilated just below the anastomosis.

(2) In a very successful case operated upon by Dr. Harvie, of New York, [2] the duodenum and œsophagus were united by direct suture, but this is neither so easy nor so safe, owing to the difficulty of mobilising the latter sufficiently without interfering seriously with its nutrition ; the jejunum can be joined without tension.

The patient was a woman, aged 46, who had had gastric symptoms for eighteen months before operation. On examination a rounded tumour could both be seen and felt. The operation was rendered difficult by adhesions both in front and behind the stomach, practically the whole of which was infiltrated and thickened. The entire stomach was removed, and the cut surfaces of the œsophagus and duodenum united by means of sutures. " The entire time consumed, from the first incision until the abdomen was closed, was one hour and five minutes. There was little or no loss of blood." The subsequent progress was most satisfactory, nourishment being first given by the mouth on the eighth day. The patient left the hospital six weeks after the operation, " after taking a dinner consisting of roast beef, mashed potatoes, ice-cream, cup of coffee, and one glass of milk."

It is more than probable that the internal secretion of the gastric mucosa is necessary to life, for the subjects of complete gastrectomy gradually become anæmic and marasmic. This makes it important to save a little of the cardiac end.

[1] *Lancet*, 1911, vol. ii, p. 430.
[2] *Ann. of Surg.*, 1900, vol. i, p. 344.

CHAPTER XV

GASTROPEXY

THIS is an operation for the correction of prolapse of the stomach. An attempt is made to keep the latter in its natural position by sewing it to the parietal peritoneum, or by shortening and strengthening its natural supports. Gastroptosis rarely occurs alone, but rather as a part of a general visceroptosis (Glenard's disease), so that even if an operation successfully restores the stomach to its natural shape and position, the patient is not necessarily cured, but may have to undergo nephropexy or colopexy as well. The latter two may be done at the same time if necessary.

It is striking that the condition is almost limited to women, who, sooner or later, become ill-nourished, thin, and nervous. The patients complain of vague pains in the abdomen and back, with a sinking feeling in the abdomen, especially when they are up and about. Vomiting and increasing constipation are almost always evident. Some regard the symptoms and visceroptosis as the results of malnutrition and of a nervous and degenerative disposition ; others, like Rovsing, think the symptoms are the direct result of the visceroptosis. He thinks the pains and nervous symptoms are due to dragging upon the nerves of the prolapsed viscera and their supports, and he regards the wasting as secondary to the indigestion and constipation. He considers the pressure of tight corsets as the main cause of the prolapse. and thus accounts for the limitation of the disease to women. He describes two forms of the disease :

(*a*) **The " Virginal,"** which occurs in women who have not borne children and whose abdominal walls are therefore unstretched and strong. In these the prolapsed stomach finds too little room in the unnatural position between the strong muscles and the lumbar spine, and becomes folded and kinked, with much pain, vomiting, and even hæmatemesis as results. The symptoms are often somewhat relieved by childbirth, but an abdominal support is useless or intolerable, and an operation is indicated.

(*b*) **The " Maternal,"** which occurs in multiparous women with thin and flabby abdominal walls. These women have less pain and complain chiefly of constipation. In these cases a good abdominal support pressing the lower part of the abdomen upwards and backwards is generally sufficient.

In some cases there is delay in emptying the stomach owing to dragging and kinking at the pylorus when the patient is upright. The stomach dilates or hypertrophies, or both. The delay and dilatation are best shown by examining the patient with the X-rays both in the

vertical and recumbent positions after a meal containing bismuth oxychloride.

Different views are held about the value of operation in these cases. Most surgeons advocate abdominal supports, but it cannot be said
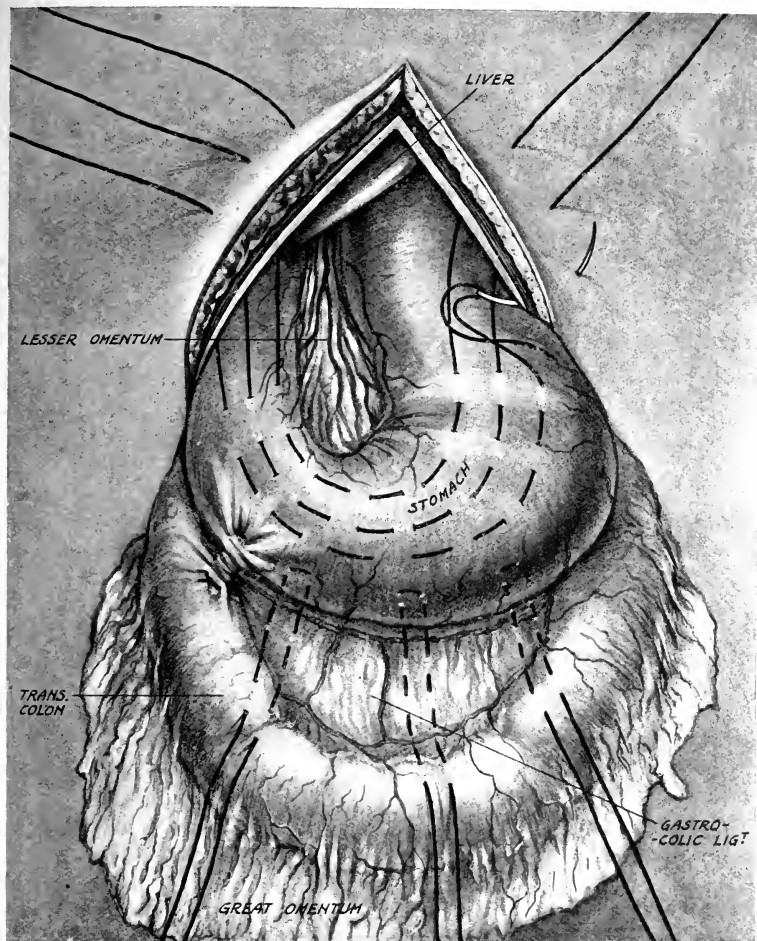
FIG. 125. Rosving's operations (mod. from *Ann. of Surg.*) of gastropexy and colopexy. Sero-muscular sutures support the stomach and colon.

that these are always successful. Others believe that operations are occasionally necessary, and others that operations should be done far more often and early enough to prevent serious symptoms and nervous phenomena. They should never be done before the abdomen has been thoroughly explored and all other possible causes of the symptoms have been excluded. Special attention should be directed to the stomach, gall-bladder, appendix, and pelvic viscera.

Operations. *Duret's Operation.* (a) Duret, of Lille,[1] was the first to perform gastropexy, and his patient was greatly relieved and gained

[1] *Revue de Chir.*, 1896, p. 430.

much weight. He made a vertical incision in the middle line above the umbilicus, only opening the peritoneum at the lower part of the incision. He then passed a single silk suture first through the left rectus, the parietal peritoneum, and the sero-muscular coats of the stomach just below the lesser curvature, and then forwards through the undivided parietal peritoneum near the upper end of the wound. In a similar way the needle picks up the stomach and parietal peritoneum several times, until at last it is brought out through the right rectus. The ends of the suture are tied, thus bringing the lesser curvature into close contact
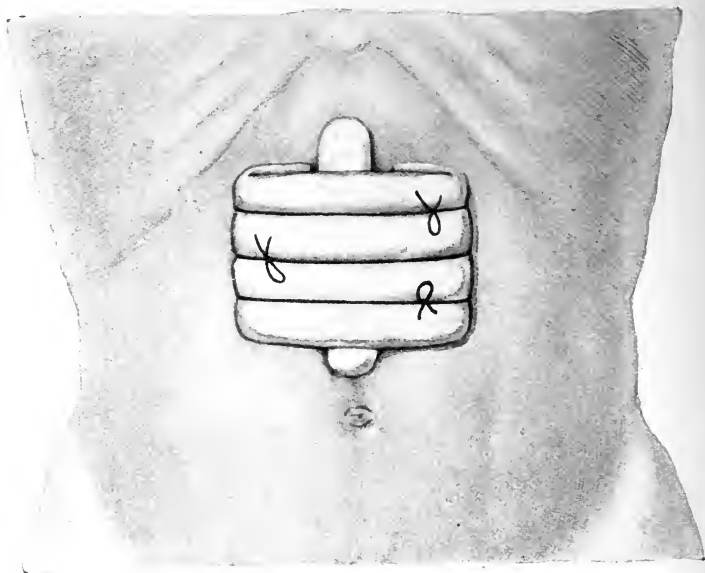
Fig. 126. Rosving's operation of gastropexy (*Ann. of Surg.*).

with the parietal peritoneum. Rosving objects to this method because it puckers the lesser curvature.

(b) *Rosving's Operation.* Rosving[1] thus describes his operation :

Parallel with the lesser curvature I lead three strong silk threads in and out through the serous coating of the anterior surface of the stomach, leaving the pyloric portion free. The upper thread is placed close under the lesser curvature, and the two others, with an interval of about 2 cm., are placed in such a way that the greater curvature and a rather large piece of the wall above this are left free (Fig. 125). With a fine needle the serosa coating between the threads is now scarified in all directions, also the surface of the parietal peritoneum, and eventually that part of the under side of the liver to which one wishes the stomach to adhere. The ends of the silk threads are led out through the entire thickness of the abdominal wall, that on the left as far as the side of the rib-curvature, and that on the right at about 3 cm. to the right of the centre line. The peritoneum is now joined with catgut, and the fascia and skin with aluminium bronze, and, after the line of wound has been covered with collodion and cotton-wool, the silk sutures are tied over a glass plate covered in sterile gauze (Fig. 126), the dimensions of which are a little larger than the stomach surface which has to be fixed. In this way it follows that the anterior surface of the stomach lies flat and close to the abdominal wall, without shrinkage and folding. These threads are left for four weeks and are then easily removed. A perfectly secure and solid adhesion is thus obtained.

[1] *Ann. of Surg.*, 1913, vol. i, p. 19.

After having employed this method with excellent results in 90 cases I allowed myself, in 1907, to be induced by Cannon's investigation as to the importance of the pre-pyloric part of the stomach with regard to the mechanical manipulation of food to modify my operation in such a way that I left the entire pre-pyloric part free, and only fixed the fundus with the aid of three silk threads, which passed transversely over the axis of the stomach and which were tied over a glass plate to the left of the centre line. With the systematic after-examination of all the cases treated with gastropexy up to January 1, 1911, the results from the latter method have proved to be far inferior to those of the former, because while the former gave 60 complete cures in 94 cases, the latter gave only 29 cures in 69 cases.
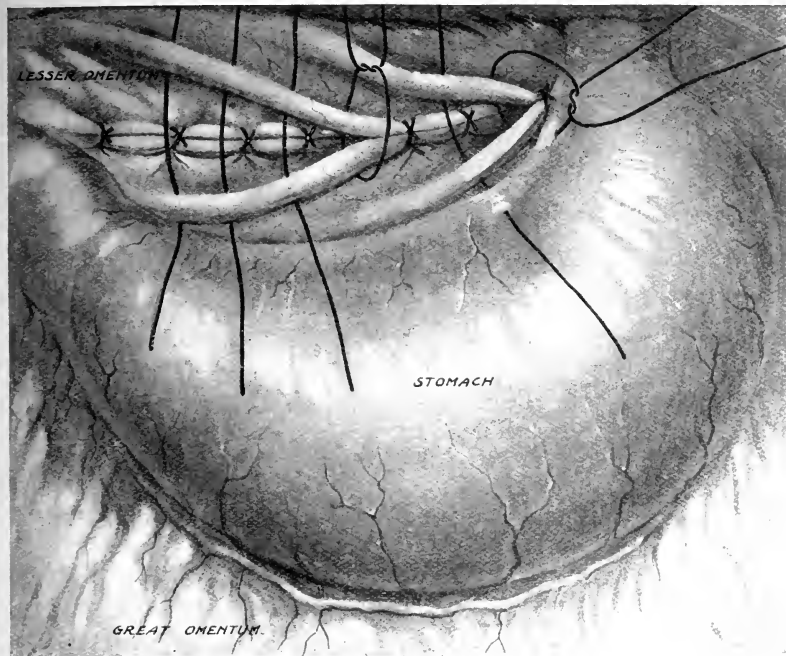
FIG. 127. Beyea's method of gastropexy.

For this reason I have returned to the former method, and have employed it with my last 30 cases, the results so far being excellent.

Since 1897, when I performed my first gastropexy, till January 1, 1911, I have myself performed the operation 163 times, and have received information from other Scandinavian surgeons of 93 operations performed in accordance with my method. All these 256 patients have been traced and their condition since the operation carefully examined, with the following result :

Analysis of results obtained in 256 Gastropexies

		Per cent.
Complete cure	162	= 63·2
Great improvement	33	= 12·8
Improvement	18	= 7
Slight improvement or no change . . .	32	= 12·8
Deaths	11	= 4·6

In all cases where the gastrocolic ligament is considerably elongated, one does not obtain by gastropexy pure and simple a lifting of the colon sufficient to remove the constipation.

In order to obtain this a special operation is required, and some of my less successful cases in earlier days are surely due to my non-appreciation of this and to later

experiments with various inferior methods. Here, the right operation has proved to be the *shortening of the omentum and the mesocolon* by basting this with the aid of a row of thick catgut threads, which commence in the serous coating of the colon and end at the greater curvature.

(c) *Beyea's Operation*.[1] Through a similar but shorter incision Beyea shortens the gastro-hepatic and gastro-phrenic ligaments by
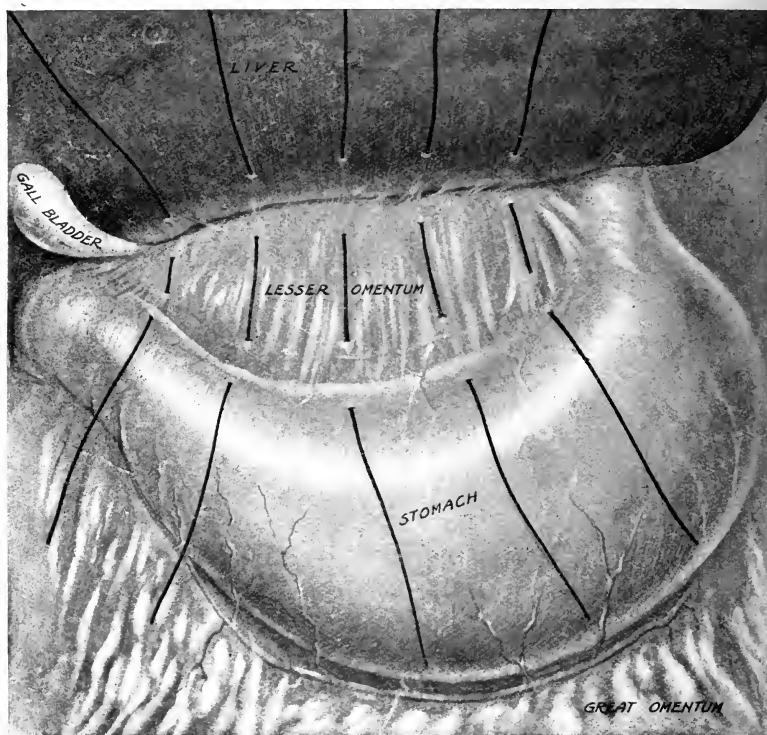
FIG. 128.   Eve's method of gastropexy.

plicating them with three rows of interrupted silk sutures, each suture, when tied, making a transverse fold (*see* Fig. 127). Bier shortens the small omentum in a similar way and also fixes the pylorus to the capsule of the liver. Both Beyea and Bier have had good results. Eve and Moynihan speak well of this method. With the last row of sutures Moynihan picks up the sero-muscular coats of the stomach just below and in front of the lesser curvature. The lesser omentum is often so thin and frail, especially at its lower part, in these cases that it is impossible to suture and fold it. Therefore Eve sews the stomach just below and in front of the lesser curvature by five or six interrupted sutures to the under surface of the liver just in front of the transverse fissure. He leaves the pylorus free, and therefore a little lower than the lesser curvature (*see* Fig. 128). He reports eleven cases with fairly good results, but only three of the patients had been watched for more than a year [2] (*see* figures).

[1] *Phil. Med. Journ.*, 1903, vol. i, p. 257.
[2] *Brit. Med. Journ.*, 1910, vol. i, p. 1100.

(*d*) *Coffey's Operation.*[1] Coffey sutures the gastro-colic omentum about one inch below the greater curvature with interrupted chromicised catgut sutures to the parietal peritoneum about one inch above the umbilicus. The width of attachment is varied with the need. In bad cases he also advises the fixation of the great omentum below the pendulous transverse colon to the parietal peritoneum. He records two cases with great improvement.

It is difficult to get a wide enough attachment, so that later on the stomach may prolapse again to the left of the fixed part, and an abrupt kink may then form at the front with partial obstruction and even ulceration.

[1] *Phil. Med. Journ.*, October 11, 1902.

CHAPTER XVI

INTESTINAL SURGERY

INTRODUCTION

THE peculiarities of the structure and contents of the intestine call for the greatest refinement of technique in order to ensure complete success, and in this respect the bowel differs very much from the stomach. The intestinal wall is much thinner and requires finer suture material, and the channel is so small, especially in children, that great care has to be taken to avoid narrowing it by careless sewing.

Although the blood-supply of the small intestine is very good, rough handling and damage to it or its blood-vessels are very liable to be followed by necrosis. The contents are very septic, especially in the lower part of the bowel. This is true in spite of care in clearing out the bowels and in giving only sterilised food for some days before the operation. On the other hand, the contents of the stomach and duodenum can be made almost innocuous in this manner. The contents of the small intestine are always liquid, and are therefore more liable to leak than the more solid fæcal matter in the colon. The contents of the cæcum also are usually fluid. These peculiarities of the small intestine make slight errors of technique, which would be immaterial in other parts, very dangerous. There is, however, some advantage in the length of the bowel, for large portions of either the small intestine or the colon can be removed when necessary without any apparent ill effect on nutrition.

Intestinal Identification and Localisation. The speedy and certain identification of different parts of the intestine is often of vital importance. Grave mistakes have been made from want of care and knowledge, *e.g.* the colon and ileum have been mistaken for the jejunum during gastro-jejunostomy. Adhesions and other pathological changes sometimes add greatly to the risk of such mistakes. The large intestine is distinguished from the small by its longitudinal bands, sacculi, appendices epiploicæ, comparatively large size, fixation, and fairly constant position ; but in infants these points are not always obvious.

The Small Intestine. The great length (fourteen to twenty-five feet) and free mobility of the small intestine make it difficult or impossible to localise a chance coil with accuracy. The only parts that can be identified at once are the duodenum, the origin of the jejunum, and the lower end of the ileum, for these are fixed and nearly constant in position. The only certain way of localising any other coil is to follow the bowel either up or down to the duodenum or cæcum. In the absence of adhesions, this can be soon done and without undue exposure, for only a short length of bowel need ever be outside the abdomen. Certain other points are valuable in arriving at rough conclusions. The small intestine

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like the colon narrows as it descends, and it gets thinner and paler. The jejunum is much thicker, larger, redder, and softer than the ileum, valvulæ conniventes can be recognised in it by drawing it between the finger and thumb, and numerous white lacteals are generally visible upon its surface.

Mall and Monks have shown that the upper third of the small intestine usually lies in the left hypochondrium, the middle third in the middle of the abdomen, and the lower third in the right iliac fossa and pelvis. Monks has also shown that the direction of the current in any coil can be swiftly ascertained by tracing its mesentery back to the spine. As is well known, the attachment of the mesentery runs downwards and to the right from the duodeno-jejunal flexure for about six inches towards the ileo-cæcal valve. If no twist is found as the mesentery is traced to its attachment, the distal end of the coil is below and to the right. In the presence of extensive adhesions this point may be of great value when relieving intestinal obstruction by anastomosis. The mesentery gets thicker as it descends, that of the jejunum is quite thin, and when held to the light its blood-vessels can be seen to be larger, their arcades fewer, and the vasa recta extending from these to the bowel longer than those of the ileum. Definite oval, clear areas can be seen between the vasa recta in the upper third of the bowel.

The Large Intestine. The large intestine is far more constant in position, so that its parts are far more easily identified. Occasionally it is transposed with or without transposition of other viscera. More commonly a partial transposition is found. For instance, the sigmoid and pelvic colon may lie on the right side in the iliac fossa and pelvis. Sometimes undue mobility of the ascending colon and cæcum may simulate transposition by allowing the cæcum and appendix to move freely so that appendicitis may cause a swelling on the left side.

In infants and children the cæcum is commonly higher than in adults, a fact of considerable importance when operating for acute appendicitis in children. In others, especially in women and the subjects of chronic constipation, the cæcum and appendix are unusually low in the pelvis. Even in some adults the cæcum is found just below the liver, and in some cases the appendix is near the foramen of Winslow. It is frequently found extending behind the colon as far as the lower pole of the right kidney.

The transverse colon is sometimes so low that it can be mistaken for the sigmoid, but this mistake should not be made owing to attachment of the great omentum to it. The cæcum is easily recognised by the termination of the ileum in it, and by its usual position at the back and outer side of the right iliac fossa, its bluish colour, thin texture, and mobility. Usually there is no mesocolon in either flank, but occasionally there is a well-developed one, especially on the left side. The absence of the usual wide retro-peritoneal surface of the colon interferes with the performance of extra-peritoneal lumbar colostomy. It is of greater importance that the fixation and peritoneal relations of the ascending and descending colon have been allowed to interfere with the surgery of this part of the bowel. For instance, the fixation makes it difficult either to bring the ascending or descending colon to the surface either in front or behind for making a proper artificial anus. It also makes it difficult to join up the bowel after the free removal of growths. These difficulties can be easily overcome by incising the

lateral peritoneal reflexions and mobilising the colon without interfering with its blood-supply, which enters on the mesial aspect. The bowel, when mobilised by gauze dissection in this way, swings freely, and this fact, long unrecognised, is of the greatest value. Moreover, the fear of leaving a raw surface in the abdomen as long as it is not a pocket has been greatly exaggerated. The difficulty of getting peritoneal apposition behind the bowel in end-to-end union can be similarly overcome, peritoneal flaps being easily available. At the junction of the mobile transverse colon, cæcum, or sigmoid with fixed parts of the colon, kinking and volvulus are apt to occur.

Methods of Sewing Wounds in the Intestine. From time to time numberless methods have been devised, but most of them have quickly become obsolete. I shall only refer to a few here, those with which I am personally acquainted and know to be simple and efficient. The essentials of a good intestinal suture are :

(i) *Simplicity.* It must be capable of easy and rapid introduction.

(ii) *Accuracy.* It must close the wound accurately without causing undue projection into the lumen of the bowel, and yet it is most important to secure peritoneal apposition.

(iii) *Security.* It must hold the parts securely together until the wound is firmly healed.

(iv) *Hæmostasis.* The turns of the suture should be close enough together to secure all blood-vessels, but the danger of hæmorrhage is not so great as in gastric surgery.

For all these reasons a continuous suture is now universally considered to be much better than a series of interrupted ones. In the introduction of the suture attention should be paid to the following points :

(*a*) As far as possible all knots upon a suture which pierces the mucosa should be within the bowel, otherwise they may draw septic fluid from within to the peritoneal surface.

(*b*) All turns should be entirely hidden by the inversion which they should produce. When these precautions are taken, there is little risk of infection of the peritoneum by fluids soaking along the sutures from the interior of the bowel. A well-introduced Connell's suture meets this ideal. In any case each suture should take a sufficiently firm hold, so as not to cut out when any strain is put upon it—*e.g.* by peristalsis or distension. Sero-muscular stitches are very apt to tear out when the tissues become inflamed and softened after three or four days, and the tough submucous coat cannot be included with any certainty or even probability, for it is much thinner than the intestinal needle in common use (*see* Fig. 129). The submucous and mucous coats are far more fibrous and durable than their outer coverings ; therefore it is necessary to pierce them in order to obtain a firm and lasting hold for the sutures. The success of the Maunsell and Connell sutures is chiefly due to the fact that they maintain inversion of the edges of the wound and accurate peritoneal apposition. They are also tied within the lumen, and this determines capillary drainage inwards towards the knots, and facilitates the discharge of the threads into the intestinal canal without risk of peritoneal infection. It is more than probable that many so-called sero-muscular sutures pierce the mucosa of the small intestine.

(*c*) The suture should be just tight enough to secure accurate apposition and stop all bleeding, but it should not be so tight as to cause

necrosis of the tissues engaged by it. For the same reason the turns of the suture should not be too near each other. As a rule these should be one-eighth of an inch apart.

(*d*) The suture material must be fine, strong, durable, and non-porous. Fine linen thread best fulfils all these ideals. Black thread has the advantage of being more visible. Linen thread is more porous, but this disadvantage can be met by steeping it in aseptic liquid paraffin. Catgut is not nearly so good for intestinal surgery, for to be strong and durable enough it has to be much thicker than suitable linen thread. Moreover, the advantages claimed for an absorbable deep stitch for gastro-jejunostomy do not apply here owing to the absence of an acid secretion.
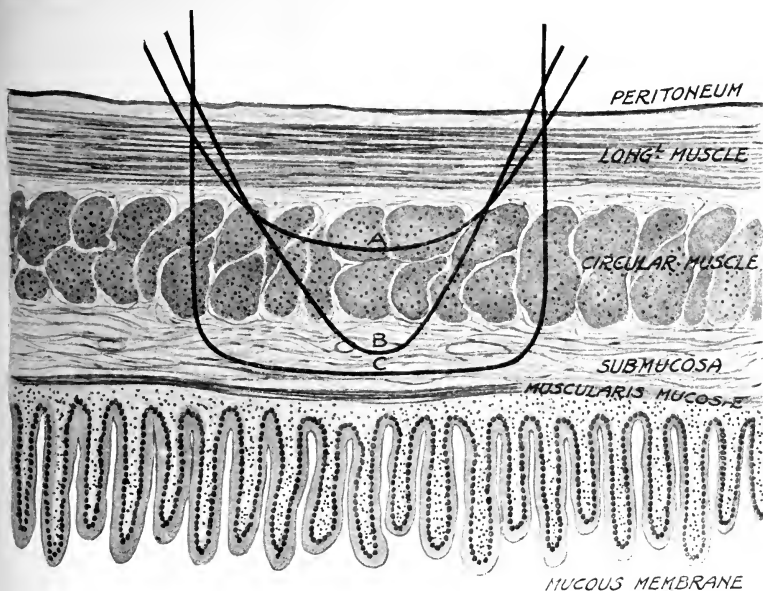
Fig. 129. Longitudinal section of intestinal wall. A, B, and C show bad, indifferent, and good methods of inserting sero-muscular sutures. The submucosa is the toughest layer. Sutures piercing all the layers hold the longest and are always used either alone or with others.

(*e*) *Needles.* The sutures are best introduced by a round-bodied needle, the aperture of which is at once plugged by the thread which follows, while its round shaft does not wound small vessels like the ordinary triangular-pointed needle, which is not needed here owing to the readiness with which the intestinal coats are penetrated. Fine quarter-curved needles are most convenient to introduce the sutures from within or at a depth. I always use a curved needle of this type and have it made not only fine, but also long enough to be easily used with the thumb and forefinger without the need of a needle-holder. The fingers are far quicker and more accurate than a needle-holder except when working in a deep cavity such as the pelvis. As far as possible all sewing of the intestine is done outside the abdomen, where the work can be completed with more ease and accuracy, and packing off is more thorough. It will save much time to have several needles threaded beforehand.

Clamps are invaluable in intestinal surgery for the reasons already mentioned under gastro-jejunostomy. Those of Doyen, Lane, and Carwardine are good.

CHIEF METHODS OF SUTURE

A. **Serous or Sero-muscular Sutures.**

(1) *Lembert's Suture* (Fig. 130). (a) *Interrupted.* The value of this depends on the fact that it fulfils in an eminent degree the condition
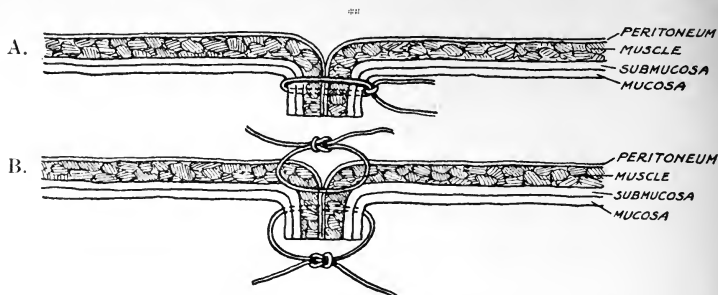
FIG. 130.   A, Shows Connell's suture and the inversion it produces.
B, Shows Lembert and Maunsell sutures.

first pointed out by the introducer, that to obtain union of an intestinal wound it is absolutely needful to bring and keep the serous surfaces in contact. Each suture should be inserted not less than a quarter of an inch from the cut edge, and run along deeply in the muscular or in the submucous coat; it is then made to emerge just wide of one cut
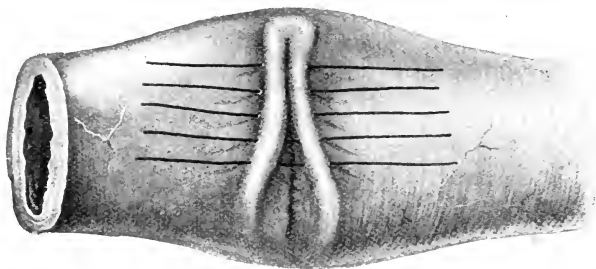
FIG. 131.   Interrupted Lembert sutures.

edge, reinserted just beyond the opposite edge, then at once made to travel between the coats and to emerge as before (*see* Fig. 131).

(b) *A Continuous Lembert Suture* is far more often used now because it saves so much time and secures better apposition (*see* Fig. 132). The objections that have been brought against it are chiefly—(i) If one part of it becomes loose the whole is liable to become insecure. (ii) It is difficult to secure even tension all along the line, unless care is taken to keep the thread always taut. (iii) If the bowel contract, the whole suture may become loosened, and the wound gape ; this calamity is far more likely to occur because the suture cuts its way out, for it may not get a firm enough hold to keep the parts in apposition long enough for good union to occur. Therefore few surgeons now trust to this stitch alone, and

most prefer to add a deep suture, which pierces the whole thickness of the wall.
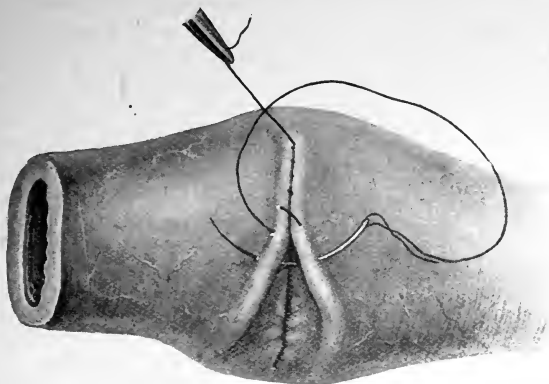
Fig. 132.   Continuous Lembert suture.

(2) *Halstead's Quilt or Mattress Suture* (Fig. 133). The distinguished surgeon who introduced this method claims for it that—(i) It is so safe
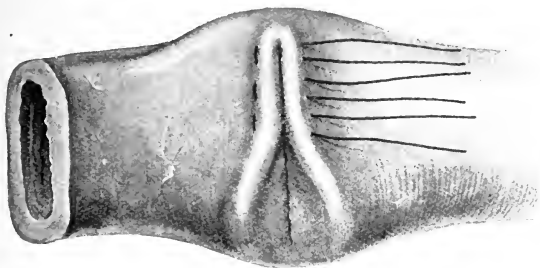
Fig. 133.   Interrupted mattress sutures (Halstead).

that a single row of it will suffice.   (ii) It constricts the tissues less than Lembert's sutures.   (iii) It tears out less readily if submitted to tension.
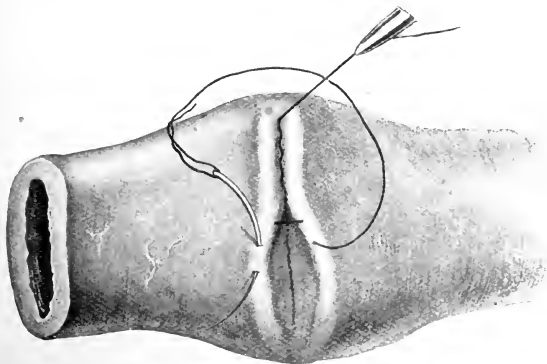
Fig. 134.   Continuous serous mattress suture (Cushing).

(3) *Cushing's Continuous Stitch* is simpler, more expeditious, and buries itself better, although it is not so firm as Halstead's interrupted

suture; the needle is passed in a direction at right angles to the axis of the bowel, and picks up the serous and muscular coats.

(4) *Purse-string Suture.* A small perforation is speedily and satisfactorily closed with a serous purse-string suture. The crushed stump of the appendix and tied ends of divided bowel are very quickly buried in the same way (*see* Fig. 135).

B. **Piercing Sutures.** These pierce all the layers of the intestinal wall and thus tend to secure a firm hold, arrest hæmorrhage, and prevent the ends parting, which is the commonest cause of death after anastomosis. In all of them the sutures are tied internally to prevent the leakage at the knot, which is the commonest site of leakage in other methods according to Chlumsky's experiments. (1) The simple suture piercing all the coats secures good apposition, is speedily inserted and prevents hæmorrhage, but it does not bury itself or secure good

Fig. 135.   Purse-string suture.

serous apposition (*see* Fig. 136. (2) Maunsell's suture, being passed from the mucosa through the inverted edges, maintains inversion, and buries itself so that it is not visible on the serous surface (*see* Figs. 130 B and 162). (3) Connell's stitch differs from that of Maunsell in that it does not pass over the edges of the wound, but is a mattress one, which secures more inversion of the edges, and is more hæmostatic; it buries itself and maintains wide serous apposition so that an additional serous suture is superfluous and may be mischievous by increasing inversion and valve formation. Experience has shown that it does not lead to sloughing of the edges (*see* Fig. 137).

Continuous perforating sutures are the best for arresting hæmorrhage, and for this purpose the turns should not be more than one-eighth of an inch apart (*see* Fig. 138).

The plan adopted by most English surgeons at the present day is to make use of a double

Fig. 136.   Simple continuous piercing suture. The tail thread, and forceps hold up the ends of the wound as the latter is sewn.

line of suture; an inner continuous one taking up all the coats of the bowel, and an outer continuous sero-muscular, both of fine linen thread.

For the small intestine I have often successfully used a continuous
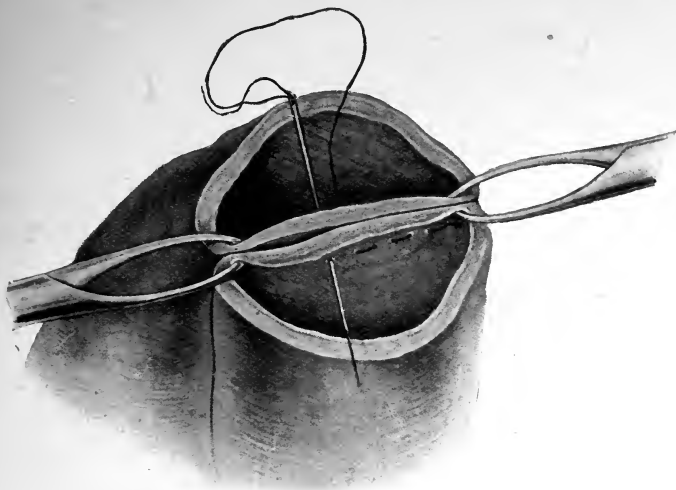
Fig. 137.   Continuous mattress or piercing Connell suture, inverting the edges.
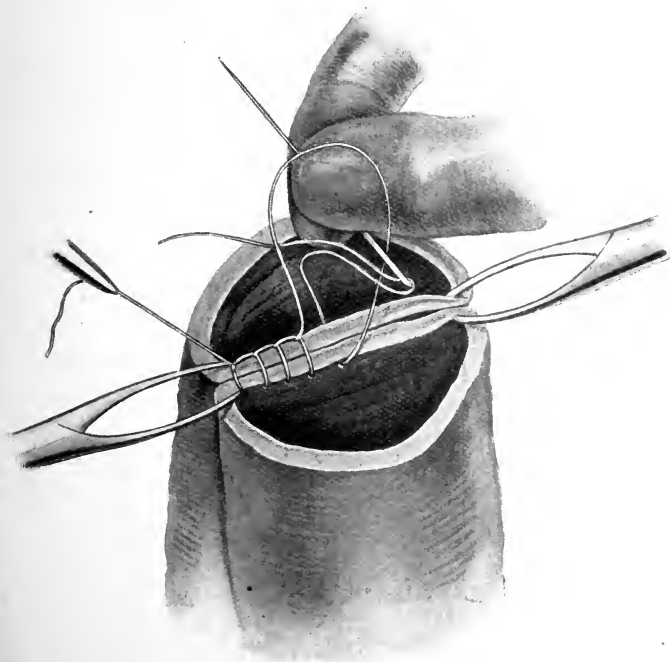
Fig. 138.   The button-hole suture which prevents slipping and puckering.

Connell suture without any reinforcement, but for the large intestine I prefer to add a serous suture.

OPERATIVE INTERFERENCE IN GUNSHOT AND OTHER INJURIES OF THE ABDOMEN. RUPTURE OF THE INTESTINE

GUNSHOT AND OTHER INJURIES

THE South African, Japanese and European wars have greatly altered our views upon military abdominal surgery, both by giving us knowledge of the effects of modern projectiles, and also by making us realise the dreadful difficulties which often make it impracticable to treat military wounds radically and without delay. In civil life it is quite different, for it is generally possible to operate under good conditions within a few hours of the catastrophe.

Indications of Penetration and Injury of Viscera. (1) *The Nature of the Injury.* Blackening of the wound and clothes with powder suggests a close shot and probable penetration.[1]

Certain severe contusions nearly always cause grave internal injuries calling for early exploration. A wheel passing over the abdomen at or below the navel often lacerates or divides the small intestine, and a kick from a horse or crushing between a van-pole and a wall or between the buffers of a train is almost certain to cause grave internal injury. Such cases, as a rule, require immediate exploration.

(2) *There may be no evidence of internal injury at all at first, but symptoms of hæmorrhage or of early peritonitis may soon appear.* Dr. Malcolm Harris [2] has very properly laid great stress upon this fact, and rightly advocates early exploration without waiting for signs of these grave conditions to develop. In civil practice this is generally possible, but it is nearly always impracticable and very dangerous under the circumstances of war.

(3) *Escape of fæces, bile, urine, or much blood* from the wound is, of course, diagnostic of penetration, but rare.

(4) *Pain, tenderness, and rigidity are the earliest and the most reliable signs* of peritoneal irritation, and when all three are associated together it is almost certain that perforation of one of the viscera has occurred.

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[1] A. B. Johnson's experiments (*Ann. of Surg.*, vol. xxxix, 1904, p. 798) have shown that the powder marks which are produced upon the skin and clothes by smokeless powder are much less distinct and definite than those caused by black powder. With Mauser and Colt pistols loaded with smokeless powder, and fired at a distance of more than one foot, no marks are formed upon the naked skin, and only very faint ones at a distance of three inches. Edges clean cut and equally stained show that the bullet has struck perpendicularly. Unequal staining and raggedness suggest obliquity of impact ; and the less perpendicular this is, the less probability of penetration. If there exists a continuous track of tenderness, especially if accompanied with slight redness, from the wound for some distance over the abdominal surface, it is fair to infer that the missile has wormed itself between the layers without penetration. (Parkes.)

[2] *Ann. of Surg.*, 1904, vol. xxxix, p. 356.

(5) *Shock.* This does not go for much unless hæmorrhage is clearly present also, owing to the great difference in individual peculiarities. Dr. Crile has shown that shock varies very much with the situation of the internal injuries, those involving the diaphragm or the stomach being attended with far more depression than those involving the pelvic or lower abdominal viscera.

(6) *A rapidly rising pulse-rate* is most alarming, but it is often below the normal in the early stages of shock. A rising temperature is of less value.

(7) *Vomiting* is an uncertain symptom, and its absence is therefore not to be relied upon.

(8) *Hæmatemesis* indicates penetration and injury to the stomach or small intestine high up. It may, however, be due to contusion.

(9) *Profuse hæmorrhage* per anum points to penetration and injury of intestine, but is seldom seen sufficiently early to be of value.

(10) *Hæmaturia* indicates injury of some part of the urinary tract.

(11) *Circumscribed dulness*, and rarely bulging near the wound or into the rectum or vagina, may indicate bleeding from a large vessel and accumulation of blood in the peritoneum, and probable visceral injury, but to be of value these signs must come on within a few hours. Free fluid may be indicated by shifting dulness in the flanks, but blood generally clots, and the dulness may not move upon changing the position of the patient. The signs of severe internal hæmorrhage are well known, but stress may be laid upon the following : Rapid small pulse, shallow sighing respiration, restlessness, pallor and shrinking of the features, dilated pupils, cold clammy skin, tinnitus aurium, dimness of vision, and delirium. The more gradual the hæmorrhage, the less will these signs and symptoms be noticed until a sudden collapse occurs. A diminishing count of red corpuscles is a sign of bleeding that may help in some cases. The symptoms of peritonitis come on sooner or later and when they are well developed, an operation offers but a forlorn hope.

(12) Rapidly vanishing liver dulness with the abdomen still flat may indicate penetration and the escape of gas from the stomach or intestine, but, if delayed, the tympanites may be due to paralysis of the intestines from shock or peritonitis.

Paralysis of any part below the level of the wound is a most grave complication, indicating, as it does, injury to the spinal cord in addition.

Other points will be the size of the bullet and the amount of fulminative or powder, the distance and direction in which the firearm was held. A single opening gives, *per se*, a faint hope that there is no penetration.

In cases of doubt as to penetration, the wound will be first enlarged, and the line of damage to the tissues carefully followed up, any exploring instruments being kept strictly aseptic.

Probable Amount of Damage. Dr. Parkes[1] gives the following suggestions : " An antero-posterior shot below the level of the umbilicus and well towards the lateral surfaces of the body will be very likely to miss the small intestines entirely, and expend its damage on the large bowel. The same kind of wound high in the lateral surfaces may pass into or through the liver without injuring the intestines, or the spleen alone if the entrance is on the left side.

" If the wound is so situated that the bullet enters the abdomen through the diaphragm, adding injury of abdominal viscera to that of

[1] *Ann. of Surg.*, November 1887.

the contents of the chest, the surgeon's help will probably be of little use. Wounds of entrance and exit, or an entrance wound alone, showing passage of the ball from side to side through the abdomen, means the worst of injuries, and suggests the need of the greatest care in staying of hæmorrhage, repair of intestines, and toilet of the contents.

" Antero-posterior perforation, if complete, can only fail to wound the small intestines when situated well on the outskirts of the surface of the abdomen ; seemingly there can be no exception to this proposition, save in those extremely rare instances in which the perforating body traverses the cavity without injuring the contents.[1]

" Penetration through the posterior walls of the cavity, if complete, with likelihood of laceration of important fixed organs, argues an injury of the most severe character, one in which the surgeon's aid will be of no avail in the majority of cases. The exceptions in which the severity will not prove insurmountable will be transit through the space between the lower end of the kidney and the crest of the ilium, and in wounds occupying the outskirts of the entire posterior surface. . . . Many instances are recorded of recovery from posterior penetration of the large and fixed viscera of the abdomen without any surgical operation."

Mr. Makins[2] agrees with most of these conclusions, and adds that wounds passing directly backwards from the iliac regions were very unfavourable on account of the liability of injury of the iliac vessels. Vertical wounds implicating the diaphragm and abdomen or abdomen and pelvis were not very unfavourable. Penetrations from the buttocks to below the umbilicus often did well, and perforations of the pelvic viscera were comparatively favourable.

" Explosive " wounds due to large leaden bullets of the Martini-Henry or " Express " type were very serious. Watson Cheyne[3] recorded a remarkable case in which a spent bullet ruptured the intestine in two places without piercing the skin of the abdomen.

Question of the Advisability of Operative Interference. A. In Civil Practice. If a capable and experienced surgeon is available an exploration should be undertaken at the earliest possible moment in order to anticipate the onset of peritonitis, and to prevent any avoidable increase of internal hæmorrhage.

For these reasons it is not even wise to wait and hope that any shock which may be present may pass off ; it is better to combat this by axillary infusion and injection of pituitary extract during the operation, after the bleeding points have been secured.

When grave doubt exists as to the existence of penetration, it is imperative to settle the question by exploration, for it is far better for a careful and aseptic surgeon to perform an occasional blank exploration than to neglect an early perforation of the bowel until symptoms of peritonitis supervene, and the chance of a successful operation has greatly diminished. By operating early astonishing recoveries occur from most extensive visceral injuries and peritoneal extravasations.

Dr. Harris[4] records sixteen consecutive operations for penetrating gunshot and other wounds of the abdomen, with thirteen recoveries.

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[1] With modern bullets it is by no means uncommon for the projectile to traverse the peritoneal cavity without leading to any symptoms or signs of perforation of the hollow viscera.

[2] *Surgical Experiences in South Africa*, 1901, chap. xi.

[3] *Brit. Med. Journ.*, May 12, 1900.

[4] *Loc. cit.*

In all but one of these cases the operation was performed within three hours of the accident. One patient died upon the operating table from profuse hæmorrhage, the source of which could not be discovered and controlled in time to save the man's life. Another man suffered severely from shock and injuries of both lungs, as well as hæmorrhage into the spinal canal. The remaining death was due to peritonitis, although the operation was performed within an hour of the accident; the eight perforations of the small intestine, sigmoid, and transverse colon had been well closed. In one case there was no visceral injury, but only hæmorrhage from a large artery in the great omentum just below the stomach. There were two blank explorations, but the bullet was found and removed in each case, and both patients recovered. " But, excluding these cases, we still have eleven cases with perforation and hæmorrhage in which operation was absolutely indicated, with but one death. Instead of the usual mortality rate of 60 per cent. to 70 per cent. following operation, we have over 90 per cent. recoveries." Dr. Harris gives two reasons for his good results : (1) the adoption of immediate operation, and (2) drainage when the gastro-intestinal tract has been opened.

Fenner [1] records six successful operations for penetrating wounds of the abdomen. One patient recovered although there were multiple perforations of the ileum ; another got well in spite of wounds of the diaphragm, stomach, liver, and pleura, with pneumothorax and pneumonia later.

Dr. Fenner also published notes of 152 operations which were performed in hospital practice between 1892 and 1901. There were 87 deaths, a mortality of 37·2 per cent. ; 113 of the operations were for gunshot injuries, with 78 deaths, a mortality of 69 per cent. The remaining 39 were for stab wounds, with 9 deaths, a mortality of only 23 per cent.

Because it is impossible to tell from the general symptoms and external appearances whether visceral injuries have occurred, Fenner advocates early exploration, and a systematic examination of all the intestine and other abdominal viscera.

Möhr [2] records forty-eight operations which were performed within four or five hours of the shooting. The mortality in these cases was only 14·5 per cent. which he estimates to be less than a third of the ordinary death-rate.

R. W. Johnson, of Baltimore,[3] records five successful operations for penetrating wounds of the abdomen. One patient had seventeen perforations of the small intestine, and eleven rents of the mesentery ; fæcal extravasation had occurred in enormous quantities, but the patient was discharged well on the twenty-first day. Amyx [4] records a recovery after nineteen perforations of the small intestine, cæcum, colon, and sigmoid flexure and four lacerations of the mesentery. Resection of eleven inches of small intestine was necessary, and an anastomosis made with a Murphy button. The remaining seven perforations were sutured. Operation commenced two hours after the shooting and lasted three hours. A gluteal abscess had to be opened later, and the bullet was found and removed.

Brown [5] publishes nine recent operations, with three deaths, one from shock and two from peritonitis which existed at the time of the operations.

Occasionally a late operation may succeed, although recovery is rarely to be expected after twenty-four hours. Pettus [6] records the

[1] *Ann. of Surg.*, January 1902.
[2] *Arch. für klin. Chir.*, vol. lxiii, Nos. 1 and 2.
[3] *New York Med. Journ.*, March 26, 1904.
[4] *Med. Rec.*, September 20, 1902.
[5] *New York Med. and Surg. Journ.*, April 16, 1904.
[6] *New York Med. Journ.*, August 30, 1902.

case of a patient who recovered although the operation was delayed for thirty-one hours, and seven perforations of the small intestine had to be sutured. Irrigation and drainage were employed.

Prof. Nancrede [1] thus states the advantages of an operation : " We can either forestall septic peritonitis or reduce its dangers to a minimum ; we can prevent sapræmia—a common cause of death, as I believe. . . . Should peritonitis have set in, we can afford sufficient drainage for the effusions, which may in themselves be already poisonous, or, as we have shown, will assuredly become the chief cause of danger ; we can substitute for adhesions of doubtful permanency certain methods which secure the escape of the injured portions of gut into the lumen of the bowel ; we can prevent the fatal results which must follow the casting off of a decomposing slough of a wounded portion of omentum or mesentery into the general peritoneal cavity ; we can arrest hæmorrhage, which from its amount will prove fatal, or from decomposition will equally produce lethal results ; we can restore the continuity of the gut, if it be nearly or completely severed, the former condition being not uncommon ; we can avoid the risk of fæcal fistula ; . . . and we can remove a hopelessly damaged kidney or spleen, and repair a wounded pancreas or liver." [2]

With regard to the presence of peritonitis, the late Mr. Greig Smith wrote : [3] " Undoubted and severe peritonitis existing on the second and third day, is by most authorities recognised as a contra-indication. In such cases it is improbable that the sites of perforation could be found ; and, if they were, that they could be dealt with without the production of excessive traumatism. There is little use in cleansing the cavity if it is to be at once refilled, and there is little use in looking for the perforations if they can neither be closed nor fixed in the wound, while there is positive danger in adding to the risk from traumatism. In such cases the most that can be done is to make a small parietal opening with the help of local anæsthesia, and permit the discharge of the noxious fluids, giving the patient the benefit of the remote chance of spontaneous cure with intestinal fistula."

It is no doubt still true that when well-marked symptoms of peritonitis have appeared surgical intervention is almost hopeless, but occasionally marvellous recoveries occur, and therefore it is well to let the pus out and drain in every case. In late cases this is all that can be done without doing more harm than good in the desperate condition of the patient. The lesions produced by the rude implements of civil life are far more serious and extensive than those due to the modern military bullet of small calibre and high velocity.

B. **In Military Practice.** Our views upon military surgery have been greatly modified by the knowledge of the effects of modern projectiles and of the difficulties which make it impossible to treat military wounds in the radical way that is generally possible and imperative in civil life.

Up to the time of the Boer War these wounds were considered to be

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[1] *Ann. of Surg.*, June 1887, p. 474.

[2] It is rare to have to remove either the kidney or the spleen in modern military practice, for the wounds which the Mauser and similar bullets inflict are usually quite small, so that packing or suture generally serves to arrest the hæmorrhage. Similar perforations of the liver also recover spontaneously in many cases. With sporting bullets and shell wounds things are very different.

[3] *Loc. supra cit.*, p. 704.

almost necessarily fatal if an abdominal section were not immediately performed, death resulting usually from hæmorrhage or from septic peritonitis.

The results of abdominal wounds made by the modern bullet have brought about a revolution as regards the question now under consideration, for it has been found that these injuries, when not immediately fatal, have been attended with far better results under expectant than operative treatment, partly because of the great dangers of operating under the very unfavourable conditions which are inseparable from war. Mr. Makins [1] divides these difficulties into administrative and surgical.

(a) *Administrative.* The surgical staff of a field hospital is better employed in attending to more hopeful cases ; and the number of assistants required at a laparotomy cannot be spared at the time when that operation would be hopeful.

(b) *Surgical.* The diagnosis of a perforating lesion is difficult, an exploration being the only sure way. The difficulties of temperature, of wind and dust, and of getting a sufficient amount of water are very great. Moreover, it is almost impossible to provide the rest and attention which are required in the after-treatment of these cases.

It is not surprising, therefore, that early explorations are not attended with great success, and that surgeons have wisely limited their number to a minimum.

Major Mallins [2] records 207 cases of penetrating wounds of the abdomen, of which 143 recovered ; in 40 per cent. of these it was impossible to diagnose a visceral lesion, as symptoms were absent. Twenty-six laparotomies were performed, with only eight recoveries. Most of the operations were performed after the development of peritonitis, so that a mortality of 69·2 per cent. is not surprising.

La Garde [3] mentions that in the Surgeon-General's report for 1900 116 operations for penetrating wounds of the abdomen are recorded, with a mortality of 70 per cent. ; the large majority of those that recovered had no intestinal injury.

I will quote some of Mr. Makins' instructive conclusions upon this subject. [4]

" (1) Wounds in the intestinal area should be watched with care. In face of the numerous spontaneous recoveries in such cases, habitual abdominal exploration is not justified under the conditions usually prevailing in the field.

" (2) The very large number excluded by this rule from operation leads us to a smaller and less satisfactory number to be divided into two categories : (a) Patients who die within the first twelve hours. Some of these patients are hopeless from the first ; a few might be saved by an operation under more favourable circumstances. (b) Patients with very severe injuries, as evidenced by the escape of fæces, or with wounds from flank to flank or taking an antero-posterior course in the abdominal area. These patients die, and the majority of them will always die whether operated on or not. The undertaking of operations on them is unpleasant to the surgeon, as being unlikely to be attended with any great degree of success, whence the impression may

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[1] *Loc. cit.*
[2] *Report on Surgical Cases noted in the South African War*, Surgeon-General Stevenson, 1905.   [3] *Med. News*, November 15, 1902.   [4] *Loc. supra cit.*

gain ground that patients are killed by the operation. None the less I think these operations ought to be undertaken when the attendant conditions allow, and it is from this class that the real successes will be drawn in the future.

" The history of such injuries after all corresponds exactly with what we were long familiar with in traumatic ruptures in civil practice, and now know may be avoided by sufficiently early interference. The whole question here is one of time, and this will always be the trouble in military work.

" (3) The expectant attitude which is obligatory under the above rules, in doubtful cases, brings us face to face with a large proportion of patients in the early or late stage of peritoneal septicæmia. These cases run on exactly the same lines as those in which the same condition is secondary to spontaneous rupture of the bowel, in which we consider it our duty to operate and in which a definite percentage of recoveries is obtained. Hence another unpleasant duty is here imposed upon the surgeon. . . .

" (4) The treatment of the cases in which an expectant attitude is followed by the advent of localised suppuration presents no difficulty. Simple incision alone is needed, and healing follows. As a rule this is a late condition.

" (5) Cases of injury to the colon, in which the posterior aspect is involved, should be treated by free opening up of the wound, and either by suture of the bowel or else its fixation to the surface. . . .

" Under really satisfactory conditions nothing that I saw in my South African experience would lead me to recommend any deviation from the ordinary rules of modern surgery, except in so far as I should be more readily inclined to believe that wounds in certain positions, already indicated, might occur without perforation of the bowel when produced by small calibre bullets ; and further, in cases where I believed the fixed portion of the large bowel was the segment of the alimentary canal that had been exposed to risk, I should not be inclined to operate hastily. . . .

" A careful consideration of the whole of the cases that I saw leaves me with the firm impression that perforating wounds of the small intestine differ in no way in their results and consequences when produced by small calibre bullets from those of everyday experience, although when there is reason merely to suspect their presence an exploration is not indicated under circumstances that may add fresh danger to the patient."

Sir F. Treves [1] mentions cases in which the abdomen was completely traversed in various directions, and yet, in spite of prolonged exposure and tedious transport, recovery took place with only very slight symptoms. In the earlier part of the Boer War he describes undertaking several abdominal sections, but he found that he was doing more harm than good, as the coils of intestine already adhered and sealed the wounds, there being no prolapse of mucous membrane or escape of intestinal contents.

It must be remembered, however, that this refers only to wounds produced by bullets such as the Mauser, which does not spread on impact, is of small diameter, and has a great velocity. Where the bullet producing the wound is one which causes more damage than the Mauser, the expectant treatment is hardly likely to be successful, and

[1] *Brit. Med. Journ.*, vol. i, 1901, p. 1156.

in such cases it is certainly justifiable to urge *as early an operation as is possible after the diagnosis of peritoneal perforation is made.*

Bowlby [1] quotes the interesting case of a man who was wounded by a Krag bullet at target practice in the Philippines. The projectile entered two inches above the left costal margin in the mammary line, and took a downward course to the left loin, where it lodged. The patient was admitted into hospital within an hour, and Robinson decided to go against the usual practice and operate at once. On exploring through a wound near the middle line he discovered and removed a large amount of fluid and clotted blood ; the bullet had pierced the omentum and mesentery, but had not injured the intestines ; the vessels were tied, and the patient recovered. Several successful early operations were performed during the South African War, but the difficulties in the way of operating in time were very great, and the unfavourable conditions generally prevented such operations being done, or contributed towards their failure.

Different reasons are given for the spontaneous recoveries that more or less frequently occurred from wounds in which the projectiles must have traversed the intestinal area. Bowlby [2] believes that the intestines entirely escape, and quotes Cheatle's case in support of this opinion. The patient was shot through the right loin, and the bullet emerged near the left anterior superior spine. After forty-eight hours the man died, and two small perforations were found in the cæcum, and a laceration of the sigmoid, but no sign of injury of the small intestine ; there was no peritonitis, which might have obliterated the evidence of perforation of the bowel. Bowlby states that as far as he is aware " the actual proof afforded by demonstration of wounded intestine which has healed is wanting." Such proof must be very difficult to obtain, of course, as the patients get well as a rule, and if any die from some other cause, all signs of small perforations may have become obliterated. There does not seem to be any reason why spontaneous recovery from very small perforations of empty small intestine should not occur occasionally, and such perforations of the stomach are well known to recover without operation sometimes, and the following is a good example : [3] A soldier was shot from front to back in the epigastrium, and remained upon the ground without food for nine days ; the enemy gave him water only ; the stomach was probably empty at the time of the injury, and this no doubt accounted for the man's recovery. Some years afterwards he died, and it was found that the bullet had pierced both walls of the stomach.

Mr. Makins [4] believes that the recoveries are largely due to the state of hunger at the time of the shooting and the very small amount of extravasation and infection, if any, that follows. The scarcity of drink and the enforced rest of the bowel and abdominal wall are also conducive to the spontaneous closure of the small perforations with lymph.

The minimal nature of the primary infection may be a factor, and this may be confirmed by the better prognosis of wounds of the large bowel except of those of the transverse colon, owing to the dryness of their contents and their comparative fixation, both of which limit extravasation (Makins). Patients with perforation of the peritoneal surfaces of the large intestine often got well after the formation and

[1] *A Civilian War Hospital*, 1901.
[2] *Loc. supra cit.*
[3] From the *Boston Med. and Surg. Journ.*, March 19, 1903.
[4] *Loc. cit.*

evacuation of a localised abscess, whereas Mr. Makins saw no similar recovery from perforation of the small intestine. He therefore concludes that spontaneous recovery after perforation of the small intestine must be very rare, but the absence of localised suppuration may be due to the less infective nature of the contents of the small intestine, especially during semi-starvation. After all, spontaneous recoveries are so rare and uncertain that under favourable circumstances the chances of the patient would be far better after an early exploration by a good surgeon. Unfortunately the circumstances of war are so unfavourable, that it is only occasionally possible to undertake operations early enough to arrest serious internal hæmorrhage or forestall the onset of peritonitis. Primary laparotomies were therefore very rare in the latter part of the South African War, and also in the practice of both Russian and Japanese surgeons during the war in the Far East, and the excellent results obtained fully justified this line of treatment.

Mr. C. A. Gill [1] concludes from his experience of the South African and Japanese Wars that there is a danger for the pendulum to swing too far towards non-interference, and he particularly draws attention to the need of more care in the early treatment and prevention of shock and sepsis. Each Japanese soldier carried tabloids of perchloride of mercury in addition to the usual first field dressing. One or more tabloids can be dissolved in the soldier's water bottle, if no other receptacle is available. The wound should be cleaned and washed with the lotion, dried, and covered with the dressing. Cleanliness of the body and clothes before going into action is also of the greatest importance. There should be facilities for urgent operations at the field hospitals, but all other operations should be deferred until the stationary field hospital or general hospital is reached.

Mr. Makins lays great stress on the need of absolute starvation in every case where perforation of the alimentary canal is suspected. At the end of twenty-four hours or more, warm water in small quantities may be cautiously given, and later milk, in teaspoonfuls only at first. Morphia should not be given in doubtful cases, for it only masks the early symptoms of peritonitis, which should be carefully looked for, so that an operation may be undertaken if possible while there is still some hope of recovery.

Operation. Iodine is invaluable in the rapid preparation of the skin which is usually required. In many cases axillary infusion is necessary before, during, or immediately after the operation.

A free incision is made near the middle line, so that a complete exploration can be carried out without delay, and the necessary repair done under the most favourable circumstances. As a rule the incision extends through the inner and middle third of the right rectus, but it may have to be made elsewhere when there are definite localising signs or the site and nature of the injury indicate it.

The abdominal wall is protected with attached sterile pads, the peritoneum opened, and the nature of any abdominal contents noticed. Gas, blood, sero-pus, food, gastric juice, fæces, bile, or urine may be found. Gauze rolls each secured at one end are passed into the pelvis and flanks to soak up the effusion. Often a damaged piece of bowel presents in the wound, or a local collection of blood or characteristic

[1] *Lancet*, 1906, vol. i, p. 1467.

fluid may indicate the site of the injury. A congested area or adherent lymph may mark a perforation of the bowel. If severe bleeding is proceeding, its source must be sought and secured at once, the aorta being meanwhile compressed by an assistant.

The small intestine is carefully but rapidly examined inch by inch from end to end. It is most convenient to commence the examination at the ileo-cæcal valve. The large intestine is also examined from the cæcum to the rectum. It is better to return each piece of intestine after examining it, evisceration being avoided as far as possible. It is important to remember that the small intestine may move far away from the position which it occupied when injured, so that a bullet passing across the lower abdomen may pierce the intestines in several places, and some of these perforations may be discovered later at the upper part of the abdominal cavity. Therefore the only safe way is to examine every inch of small intestine carefully, however well and certainly the course of the bullet may be known. Makins[1] draws attention to the fact that there is generally a characteristic area of redness around perforations of the intestines. This is of great help in finding the lesions. He also points out that wounds near the mesenteric border are quite common in military practice, which is in contrast with civil practice, and adds considerably to the risks of hæmorrhage and septic infection.

Small or moderate lacerations limited to the sero-muscular coats are repaired by continuous Lembert or Cushing sutures without narrowing the lumen. Sometimes when these coats are extensively torn and stripped off, enterectomy is the safest procedure, but it is wonderful how much can be done by careful sewing and borrowing omental grafts.

Small perforations are closed by a deep suture piercing all the coats and a pursestring serous suture, both of fine linen thread. Clamps are always used to prevent further extravasation during sewing. The edges of large perforations often require refreshing, pouting mucous membrane or damaged tissues being pared off. Two continuous sutures of fine linen thread are introduced, while the wound is so held with tissue forceps that it becomes transverse to the axis of the bowel. This method prevents narrowing of the lumen. Clean-cut lacerations only require careful closing with two continuous sutures. When there are several severe lacerations near each other, or mesenteric injuries damaging the bowel or its blood-supply irretrievably, resection is necessary. The channel is restored either by end-to-end union or preferably by lateral anastomosis after closing each end with a continuous piercing suture and invaginating it with two purse-string serous sutures. These will be described later.

Wounds of the mesentery and omentum are sewn after bleeding vessels have been tied. Wounds of the stomach, gall-bladder, or urinary bladder are closed in a similar way, but for these the deep suture should be absorbable and therefore of catgut. Wounds of the liver, kidney, spleen, and pancreas are sewn whenever possible; some have to be packed to arrest hæmorrhage. Sometimes excision of the spleen or kidney is the only satisfactory treatment. The packs are removed, the peritoneum cleaned with moist gauze, and the abdomen is closed as a rule without drainage. Late cases with peritonitis or local collections of pus require temporary drainage.

[1] *Loc. cit.*

Retro-peritoneal wounds of the colon are rarely discovered until emphysema and local extravasations and infection of the cellular tissues occur. These call for free drainage, for an attempt to close such perforations is doomed to failure. As a rule the perforations gradually heal; if not, a proximal colostomy may be needed for a time.

The valuable contributions of Makins, Bowlby, Stevenson, Treves, and others upon the South African War have been already referred to. Still more recent and some very instructive papers have been written by Harris, Fenner, Gill, Le Conte, La Garde, and have been alluded to. An interesting case is recorded by Senn.[1] The jejunum, ileum, hepatic flexure of the colon, ascending colon, and cæcum were wounded. Some of the jejunum had to be resected, the other intestinal and some mesenteric wounds were closed, mostly by two rows of sutures, the peritoneum was wiped out, and the patient recovered. Brewer[2] records a successful operation for a pistol wound of the liver, gall-bladder and stomach, and mesocolon; three perforations of the stomach and one ragged one in the gall-bladder were sutured, and much blood removed. Two days later the wound had to be reopened owing to an accumulation of biliary discharge from the liver wound.

RUPTURE OF THE INTESTINE

Contusions, unlike gunshot and other penetrating wounds, do not so often cause multiple injuries of the bowel, but the individual lacerations of intestine and mesentery are generally more severe For instance, the small intestine is sometimes completely divided. Therefore it is clear that the hope of recovery without operation is more remote, but that the operation itself is likely to be less tedious and troublesome.

Relative Frequency of Rupture in 113 Cases.[3] Duodenum, 6; jejunum, 44; ileum, 38; " other parts of small intestine," 21; large intestine, 4. While the duodenum and large intestine escape from their sheltered position, the jejunum is most frequently ruptured in its first three feet, the ileum in its last three. Fæcal extravasation is almost invariably present. The most frequent and important complication of ruptured intestine is laceration or contusion of the mesentery; this is important from the rapidly fatal hæmorrhage, or later gangrene. The cases of ruptured intestine fall clinically into three classes : (A) The shock never leaves the patient, may never lessen, but pass, rapidly or slowly, into fatal collapse. This may be due—(1) to the shock of the accident; (2) to hæmorrhage; (3) to fæcal extravasation. (B) Those in which evident peritonitis develops. The diagnosis is easiest in these cases, but unfortunately they are not the most common. (C) The most common. Instead of evident peritonitis setting in after reaction has taken place, vague symptoms appear, keeping the surgeon in expectation of it, but giving nothing on which he can found a positive diagnosis, for the same slight indications are common in cases in which ultimate recovery has taken place. The patient is apathetic, seemingly satisfied with his condition, and thus misleading; or, getting gradually weaker, and therefore being less able to complain, appears to be improving. Peritonitis in this group of cases develops so slowly that its beginning cannot be noted.

[1] *Ann. of Surg.*, 1905, vol. xli, p. 637.
[2] *Ibid.* 1904, vol. xxxix, p. 100.
[3] Curtis, *Amer. Journ. Med. Sci.*, October 1887.

James Berry and Giuseppi [1] have done good service by collecting and analysing 132 cases of rupture of the intestine from contusion from the records of ten London hospitals previous to 1908. The intestine is crushed between the spine or ileum and the force employed, the more severe the blow, *e.g.* such as run-over or a kick from a horse, the more likely is the intestine to be injured.

<div align="center">Cause</div>

Run over	51
Squeeze or crush	24
Blow	23
Kick	16
Fall	11
Reduction of hernia	1

<div align="center">Site of Rupture</div>

Large intestine	110
Small ,, ...	15
Duodenum	23
Duodeno-jejunal flexure	3
Jejunum	32
Ileum	32
"Small intestine"	25
Large and small	4
Partial rupture	17
Multiple ruptures, mostly close together	22
Bowel cut across	15
Retro-peritoneal rupture (three of these were duodenal) . . .	4
Mesentery torn	15
Complications such as ruptured liver, spleen, or fractured pelvis .	24

Diagnosis. The most important symptoms and signs are :

Early and severe pain, repeated vomiting, local tenderness and rigidity, dulness locally or in flanks. Shock may be extreme, but may be so slight that the patient is able to go on working for several hours. A consideration of the nature of the injury is very important.

Senn [2] draws attention to the possible occurrence of rupture of the intestine from indirect violence, such as falls upon the buttocks, and records the interesting case of a woman who fell upon the right buttock, and six hours later was seized with violent abdominal pain. When Senn saw her two days later she was very ill with general peritonitis, and upon exploring a small laceration of the jejunum was discovered after a long search.

Le Conte [3] in his address on " Surgery " before the Philadelphia Academy of Surgery, discusses the diagnosis of intestinal injuries very thoroughly, and lays stress upon the importance and gravity of a steadily increasing pulse-rate, an anxious, careworn, and painful expression of the face, and the recurrence of vomiting after reaction. Brewer also read a valuable paper upon this subject before the New York Surgical Society, [4] and strongly advocates early operation. He places most reliance upon the association of pain, tenderness, and rigidity. Evidence of the presence of free fluid in the peritoneum is also important. The signs of internal hæmorrhage have already been alluded to at p. 227.

[1] *Lancet,* 1908, vol. ii, p. 1143.
[2] *Amer. Journ. Med. Sci.,* June 1904.
[3] *Ann. of Surg.,* 1903, vol. xxxvii, p. 525.
[4] *Ibid.* 1903, vol. xxxvii, p. 197.

A certain diagnosis is seldom possible for twelve hours or longer, but the surgeon should not wait on this account. The risk nowadays of doing harm by exploring, in cases where no laceration of the intestine or mesentery is present, is much less than that of waiting to explore until the onset of a septic peritonitis affords certain evidence. As in intestinal obstruction, abdominal section is the only means of clearing up the diagnosis. That the best chance is afforded by early operation as soon as the period of shock has passed off, is proved by recorded results.

The prognosis depends on the extent of injury, the amount of extravasation, and the amount of delay before operating. Siegel collected 376 cases which were operated upon, with a mortality of 51·6 per cent. The following figures concerning these cases prove the importance and value of early operation :

	Per cent.
Cases operated upon first four hours, mortality . . .	15·2
,, ,, ,, ,, five to eight hours, mortality . .	44·4
,, ,, ,, ,, nine to twelve hours, mortality .	63·6
,, ,, ,, later	70·0

Of Berry's collection, eighty-four patients were operated upon with sixty-seven deaths, a mortality of 80 per cent., but in fifteen the ruptures were not found at the operation. Seven of these were in the duodenum. Hence the great importance of carefully examining this part of the bowel and in making a thorough general exploration. This appalling mortality was chiefly due to delay before operation, and the severity of the intestinal and associated injuries, and partly to errors of technique.

Operation. This differs in no essential from that already described under gunshot injuries.

Mr. Croft has recorded two cases of rupture of the small intestine without external wound.[1] These must be looked upon as pioneering cases, as far as this country goes, in the modern treatment of these injuries. Both patients recovered—the one completely, after primary enterorraphy by Lembert's method ; in the other case an artificial anus was made. This was closed by resection of the intestines four weeks later, but the patient sank, thirteen hours after the operation, from exhaustion, due chiefly to " the irrepressible escape of intestinal contents at the artificial anus."

I can only find space for one other of these most interesting cases. It is recorded by Mr. W. T. Thomas, assistant surgeon to the Royal Infirmary at Liverpool.[2] It presents the following points of interest :

(1) The slightness of the injury. The patient, aged 55, had, twenty-four hours before the operation, struck her abdomen against a chair which she was carrying before her, and which caught against a door-post. (2) The absence of symptoms in a case of severe septic peritonitis, only distension and tenderness being present. When the abdomen was opened, about half a pint of putrid serum, with large yellowish flakes of puriform lymph, escaped. The intestines were all distended, and, as no collapsed coils could be found, the small intestine was withdrawn. After two feet had been examined, a perforation was found about three-quarters of an inch long, from which oozed fæcal fluid. This was closed by two rows of continuous Lembert's sutures, the mucous membrane being carefully tucked in. Thorough irrigation was then carried out, a glass tube being left in. The patient made a good recovery.

Interesting and instructive cases will be found related in the recent papers of Brewer, Senn, Le Conte, and Berry, which have been already referred to.

[1] *Clin. Soc. Trans.*, vol. xxi, p. 254, and vol. xxiii, p. 141.
[2] *Brit. Med. Journ.*, vol. i, 1894, p. 1355.

CHAPTER XVIII

ENTEROTOMY, ENTEROSTOMY, COLOTOMY, COLOSTOMY, APPENDICOSTOMY

ENTEROTOMY

In this operation the small intestine is incised for the removal of some abnormal or noxious contents, for instance a foreign body accidentally or purposely swallowed, a fæcolith or a biliary calculus. Sometimes the decomposing contents of the intestine are removed during an operation for intestinal obstruction or peritonitis.

For the Removal of a Foreign Body. The latter is backed into a healthy part of the bowel, and the coil of intestine containing it is brought out through a median incision and surrounded with gauze packs, emptied of fluid contents, and clamped. A longitudinal incision of suitable length is made along the free border of the intestine, and the foreign body is removed. The pouch is cleansed with moist swabs and the wound is closed with two continuous sutures of fine linen thread. The knots of the deep piercing suture are tied within the lumen of the bowel. Often it is necessary to make the suture line transverse to the axis of the bowel (see Figs. 132–136).

For emptying Fluid Contents. A coil a little way above the obstruction is chosen because its wall is healthier. This is packed off, and at the selected point near the free border of the distended coil, a purse-string sero-muscular suture is inserted. A trocar and cannula with rubber tube attached are inserted to conduct the gaseous and liquid contents well away from the operation table. The puncture is closed by tying the purse-string suture as the cannula is withdrawn. When the distension is more extensive and severe, the bowel is clamped and incised sufficiently for the insertion of a small Paul's tube with rubber tubing attached. This is surrounded with packs and left in for a time, while the cause of obstruction is sought and treated. Sir Berkeley Moynihan uses a glass tube six to eight inches long with rubber tubing attached. (Fig. 182.) He passes the tube up the bowel, and draws the latter over the tube as each coil is emptied. Sometimes he passes it eight or ten feet up. The incision in the intestine is closed with two continuous sutures of fine linen thread. The deep or piercing one is of the Connell type, and its knots are tied within the lumen. To avoid obstruction the suture line is usually transverse to the axis of the bowel.

ENTEROSTOMY

In this operation an opening is made into the small intestine either (a) for feeding purposes in some late cases of growth involving nearly

the whole of the stomach, or (b) for temporary drainage in late cases of intestinal obstruction or paralytic distension.

(a) **Enterostomy for Feeding Purposes.** Here everything is done to prevent leakage of the intestinal contents ; therefore a very different type of opening is made.   It is clear that such an opening is of greater value the higher it is in the bowel.   The duodenum is so fixed as to be unavailable for the best type of valvular opening ; therefore the early part of the jejunum is nearly always selected.

Jejunostomy.   This operation has the serious disadvantage of being liable to leakage at a point high up in the alimentary canal, where the fluids traversing the bowel are of the greatest importance from a nutritive point of view.   Thus it has followed in the majority of cases that no great prolongation of life has resulted from this operation.   Dr. Hahn[1] gives a list of five cases of jejunostomy.   One, a case of gastric carcinoma, died in a fortnight ; another, a case of œsophageal carcinoma, died in four days ;   the third, a girl aged twenty-three, who five weeks before had drunk sulphuric acid, died on the eighth day.   Mr. Jessett[2] relates two cases operated on for œsophageal carcinoma.   One survived nine months, when extension of the disease proved fatal.   The other only survived seven weeks.   Mr. Golding-Bird brought a case before the Clinical Society ;[3] here the operation was performed for advanced carcinoma of the pylorus.   The patient was making a good recovery up to the ninth day, when fatal peritonitis occurred owing to an accident in the feeding.   Loyel found that the average duration of life in twenty-five cases was only eighty-seven days.   Modern improvements in the operation have proved of value in preventing leakage and diminishing the mortality.   The writer performed Maydl's operation on a man with diffuse and late carcinoma of the stomach.   The patient was greatly relieved for six months, but in spite of a distance of six inches between the opening and the lateral implantation, regurgitation of food and irritating secretions occasionally occurred.   To prevent this, the piece of jejunum in the abdominal wall may be twisted half a circle or carried obliquely outwards between the rectus and its sheath.

Indications.   (i) Extensive carcinoma of the stomach where other operations are impossible.   (ii) Extensive carcinoma of the cardiac end of the stomach and œsophagus when gastrostomy is out of the question. (iii) Cases of simple general cicatricial contraction of the stomach, the effect of caustic liquids.   It has been suggested also as a means of treating gastric hæmorrhage, but this suggestion is to be condemned. (iv) It has also been suggested as a temporary measure for gastro-jejunocolic fistula when the patient's condition is too bad for a radical operation.

Operations.   Two methods will be briefly described : (i) Maydl's method.   (ii) An adaptation of Witzel method of gastrostomy.

The abdomen is opened through the upper part of the left rectus and the duodeno-jejunal flexure is sought..   The transverse colon is drawn forwards with the left hand, while the right forefinger passes backwards and to the left along the under surface of the mesocolon until it feels the jejunum at its origin just to the left of the spine, and hooks it forwards.   The ligament of Treitz is seen joining the flexure to the mesocolon.   The jejunum is then traced down for about eight

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[1] *Deutsch med. Woch.*, 1894.
[2] *Dis. of the Stomach and Intestines,* p. 64.
[3] *Trans.*, vol. xix, p. 70.

inches, and a loop is brought out of the abdomen and packed off. So far the operations are alike.

(1) *Maydl's Method*. The loop is emptied and clamped across at its base, the clamp securing both limbs of the loop and the mesentery. The intestine is cut across and the mesentery is tied and incised to the required degree. The proximal open end is implanted into the side of the distal part at least six inches down, the remaining end is fixed in the parietal wound (*see* Fig. 139). The peristalsis in the part of the
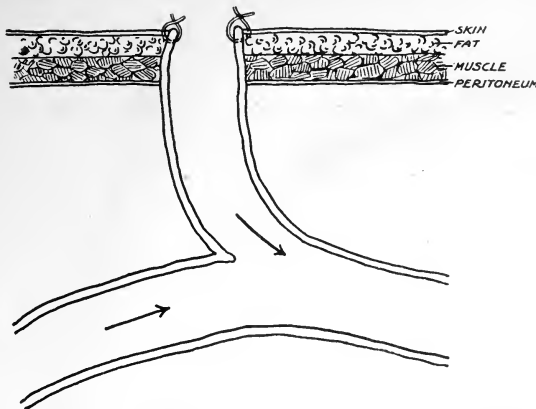
Fig. 139. Jejunostomy, Maydl's method. The jejunum is shown in longitudinal section.

bowel which is joined to the wound is away from the fistulous opening. This operation resembles Roux's method of gastro-jejunostomy.

(2) *An Adaptation of Witzel Method of Gastrostomy*. A small opening is made into the intestine near the distal extremity of the exposed loop and on the side opposite to the mesentery. A rubber tube about the size of a No. 12 catheter is inserted and fixed by a single catgut stitch, which includes the cut edge of the bowel and the side of the tube. The tube is laid upon the ante-mesenteric border (towards the origin of the jejunum), and buried by means of a continuous suture (*see* Figs. 140 and 141). The tube should be buried for about two inches, and the suture should extend well below the opening into the intestine. The intestine is fixed to the parietal peritoneum, and the wound closed around the tube, which is left long. A funnel may be inserted in the end of the tube for feeding purposes. At first only about six to ten ounces are given. Mr. Golding-Bird found that a meal of fifteen or twenty ounces every four hours caused symptoms of over-distension. Moynihan states that "after the first few days up to a pint may be given in the space of ten minutes."

(*b*) **For Temporary Drainage**. When the bowel is considerably damaged and paralysed, and the patient is very ill, it is sometimes necessary to drain it for a few days to enable it to recover its natural condition. Whenever possible, the cause of the obstruction is removed before the abdomen is closed, but in some cases this has to be deferred until the condition of the patient has improved sufficiently. When the cause of obstruction has been removed the enterostomy should be closed under local anæsthesia within two days or as soon as the vomiting has stopped. The enterostomy is no longer necessary, it has served its

purpose, and is far easier to close at this early period.   When the cause
of obstruction has not been removed at the primary operation, the
enterostomy cannot be closed until the obstruction is removed.   When
the obstruction is irremovable an enterostomy should not be performed,
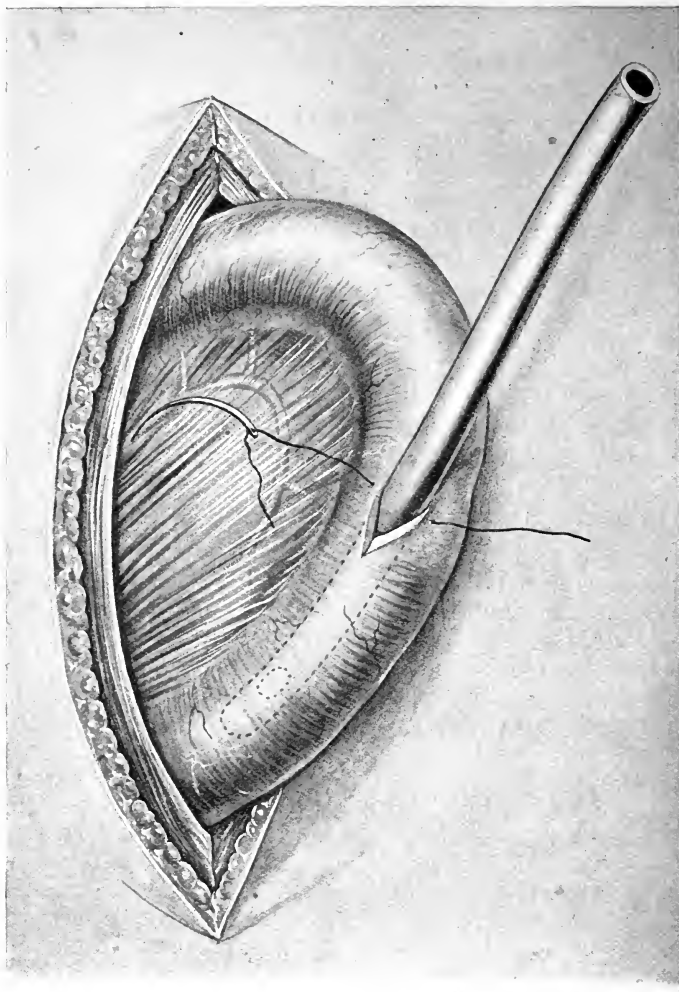
Fig. 140.   Jejunostomy after Witzel's method of gastrostomy, first-stage.
The tube is fixed by a suture.

for a permanent artificial anus in the small intestine is intolerable. The
higher it is the more intolerable, for much of the food is wasted, and the
patient gets thin and also miserable from irritation of the skin.   In
these cases it is far better to make an anastomosis between the bowel
above and below the obstruction.

Operation.   The selected coil is withdrawn, emptied, packed, and
clamped off, while a purse-string suture piercing all the coats of the
bowel is inserted near the free border.   Within this circle an opening just

large enough to admit a small Paul's tube or other enterostomy tube with rubber tubing attached, is inserted and tied in (*see* Fig. 142). The clamp is then removed, the coil wiped with moist swabs, and returned into the abdomen. No sutures are necessary between the bowel and the abdominal
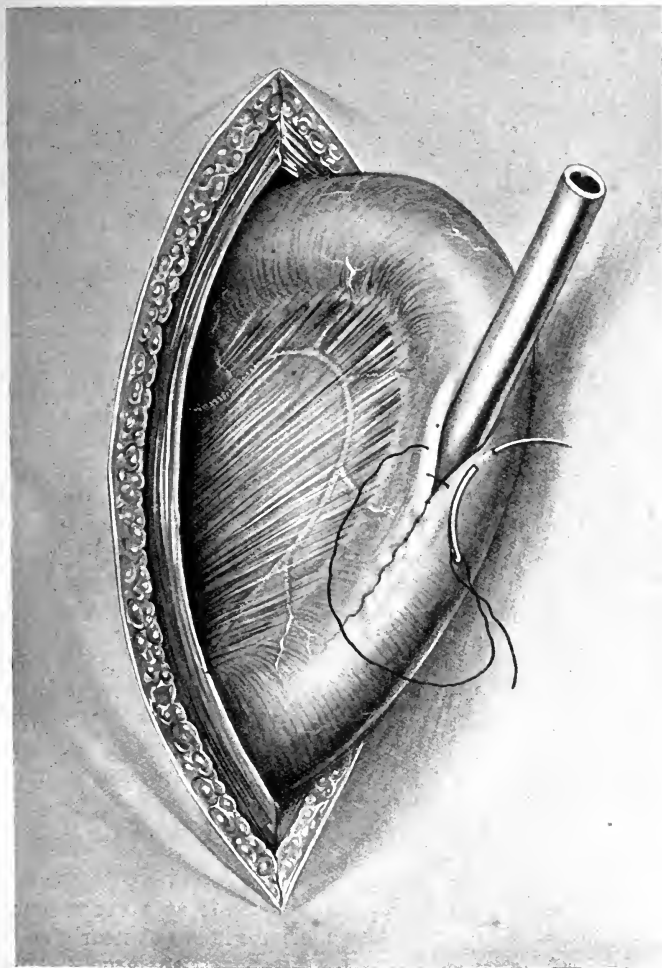
FIG. 141. Jejunostomy after Witzel's method of gastrostomy, second stage. The Cushing suture is introduced.

wall, although some surgeons insert a few between the bowel near the tube and the parietal peritoneum. The enterostomy tube is fixed by a tape tied to it and round the abdomen. Failing a special enterostomy tube, a long piece of rubber tubing the size of a No. 16 catheter answers admirably if a single suture is passed through it and the edges of the intestinal wound before the purse-string suture is tied. The abdominal wound is closed in layers around the enterostomy tube, just above and below which wicks of gauze are placed. As soon as possible the enter-

ostomy is closed. Usually the tube loosens and comes away about the fourth day.

COLOTOMY

Occasionally the colon is incised for the relief of great distension, mostly gaseous, during operations for intestinal obstruction, *e.g.* a volvulus of the sigmoid colon may be irreducible until the enormous distension is relieved. As a rule it is sufficient to puncture the distended bowel with a small trocar and cannula, or even a large cutting needle, when the gas at once escapes. The puncture is made at or near a longitudinal band and within the circle of a purse-string sero-muscular suture, which is tied as the cannula is withdrawn.

Sometimes a free incision is necessary for the removal of a foreign body, gall-stone, or hard fæcolith, which cannot be removed in any other way. The incision is made through and along a longitudinal band. Whenever possible, the loop of bowel is withdrawn, packed off and clamped. The wound is closed with two continuous Connell and Cushing sutures of fine linen thread and one or more of the appendices epiploicæ are tacked over the suture line.

Fig. 142. Enterostomy for temporary drainage. The glass tube is of small calibre ($\frac{1}{3}$ inch diameter) so that the fistula can be easily closed after a few days. The purse-string pierces all the coats of the intestine.

COLOSTOMY

In this operation an artificial anus is made at a convenient site in the colon. Except as a temporary measure it is not nearly so common as it used to be some years ago, for it has been largely replaced by short-circuiting and radical operations for growths of the colon and rectum.

The question of the value of colostomy, compared with excision of the rectum, in cases of cancer is dealt with later on.

Before describing and comparing the different modes of performing colostomy I shall deal with those conditions which call for this procedure, then the advantages of the chief methods and the cases to which they are relatively adapted, describing finally the operations themselves.

Indications for Colostomy. (1) *Certain cases of malignant disease of the rectum :* (i) where *obstruction* is present, impending, or threatening; (ii) where, in cases which are too advanced for excision, there is extensive ulceration, great pain, difficult defæcation, loss of sphincter power;

profuse blood-stained or fæco-purulent discharge from the bowel, or multiple fistulæ, especially recto-vesical fistula, the operation is abundantly justified.

As a rule, the more complete the failure of previous treatment, the more painful, difficult, frequent, and unsatisfactory the action of the bowels, the greater the tendency to distension of the sigmoid or lower intestines generally, the more frequent the attacks of gripings and partial obstructions which herald in the tormina of a complete *miserere*, the younger the patient, and thus the longer the natural prospect of active life, the more plain are the indications for colostomy. On the one hand, certain special evils[1] call loudly for the relief which the operation may give, viz. a patulous or invaded sphincter allowing of involuntary escape of flatus and fæces; multiple fistulæ giving rise to foul sanious discharge, keeping the patient (perhaps a woman of scrupulous cleanliness) in a constantly filthy condition, and leading to a brawny, painful condition of the buttocks, which thus readily become the seat of cellulitis and its allies; projection of the growth downwards through the anus, leading not only to a patulous sphincter, and its consequent wretchedness, but also to irksome or painful sitting.

On the other hand, certain conditions contra-indicate the operation, viz. exhaustion of strength, evidence of secondary deposits in the peritoneal cavity or liver, extension to the inguinal glands, and absence of much pain or obstruction from first to last.

It has been too much taken for granted, because rectal cancer is often a disease of much suffering, and because, from the inefficiency or neglect of treatment, obstruction does occur, that when cancer of the rectum is diagnosed, the patient has therefore agonising pain and obstruction to look forward to. The above view is quite incorrect. In a few cases cancer of the large intestine may run its course, and set up visceral deposits, and kill the patient with very little pain, and no threatening of obstruction[2] whatever; in other cases—and they form a considerable number, and would be still more numerous if efficient treatment were begun early and persevered with—careful attention to diet, regular use of laxatives, daily washing out of the bowel with warm water by a soft catheter or œsophagus-tube passed *through* the stricture, followed by the injection of starch and laudanum, or a suppository of cocaine, iodoform, and morphia, will give great comfort for the rest of the day, entirely prevent obstruction, and enable the patient to get about and go to business almost to the last.

Other very important points, on which the patient or the friends, especially if in a better rank of life, will frequently expect a decided answer, are the amount of relief, and also the amount of annoyance, which will follow the formation of an artificial anus.

The amount of relief given will depend on the amount of pain the patient has, the degree to which obstruction is threatening, or the presence of special miseries such as those alluded to above. Patients may be assured that any continuous pain will be greatly lessened in

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[1] To quote only two special wretchednesses—*e.g.* when a lady cannot rise from her easy-chair without an escape of flatus or fæces taking place from a powerless sphincter; or when a man is threatened with agonies of pain from the carcinoma eating backwards and involving the sacral nerves, and causing caries of the sacrum with fistulæ and foul discharge.

[2] In a few cases the growth may, instead of projecting into and obstructing the lumen of the bowel, have led by ulceration to enlargement of the gut into a cavern-like space.

severity, if not entirely removed ; that defæcation will become easy, painless, and, after the first four or six weeks, limited to one motion a day, save when diarrhœa is present ; and that the distress of constant desire to go to stool, and tenesmus, will diminish.[1]

The other part of the question—the amount of annoyance following on an artificial anus—must be honestly met. There is too great a tendency amongst writers on colostomy to teach that if the operation is done sufficiently early, and if its immediate risks are survived, the relief is *always* decided, and the patient's condition *always* a most satisfactory one. This tendency has largely arisen from colostomy being so often performed on hospital patients whom it is so difficult to keep long under observation. While it is always right to remember that the disease is a mortal one, and that if a fair comparison is to be made, it must be not between the condition with an artificial anus and that of perfect health, but between an artificial anus and a bowel with incurable cancer, the patient's after-condition will be materially affected by his position in life. Where a patient's remaining days are easy, where he can continue to be careful in his food to avoid diarrhœa, where he can pay regular attention to the opening, this may give little annoyance ; and it is also a rule that the greater the miseries of pain and frequent and difficult defæcation from which the patient has been relieved by colostomy, the more easily does he forget any annoyance of the anus in his relief at what he has escaped from in the past. But, on the other hand, where the surroundings of the patient compel him to try and work, the friction of any prolapsed bowel which follows on movements of the thigh and groin, the difficulty of paying attention to the opening, of avoiding diarrhœa from unsuitable food, of washing out the lower bowel—all these may mean that colostomy has only enabled the patient to exchange a life of miseries for one of annoyances—the annoyances of the opening for the miseries of the disease ; annoyances certainly less important, but not the less present to the patient because they were unexpected. And, as I have said before, the less urgent the conditions for which the colostomy was done, the less the patient has been relieved from, the more actively will the annoyances of the artificial opening be present to his mind. The more frequently a surgeon performs this operation, the more readily will he admit that there are cases in which colostomy, though well performed, fails to give the expected amount of relief.

Putting aside cases where the operation is performed too late, and where the local mischief has been allowed to become too advanced, those where secondary deposits exist, cases where the opening has been too free, or where, with a proper opening, a constant cough, aided by a relaxed condition of tissues, tends to bring about a worrying prolapsus, —putting aside cases in which the opening was perhaps originally too small, or in which the patient does not take the trouble to keep the opening dilated as directed—I am of opinion that occasionally cases of failure to give complete relief are met with after an operation quite properly carried out. While I cannot give, and have failed to meet, an explanation for every case, I think the following are *bonâ fide* causes, and without detracting seriously from the value of this excellent operation, because only occasional, I feel that they have been somewhat unduly overlooked.

[1] *I.e.* if the opening is free, if there be a good " spur," and no fæces find their way into the bowel below, but discharges from the growth may cause tenesmus.

Some of these instances of incomplete relief, viz. persistent passage of motions over the malignant disease and teasing diarrhœa from the artificial and natural anus, have seemed to me to be due—(a) to the lower communication with the bowel being too patent, sometimes no doubt accounted for by the fact that the colon, at the spot where it has been drawn into the wound, owing to the shallowness of the loin or the length of the mesocolon, is scarcely kinked or bent at all : this leads to escape of fæces over the malignant growth, and much pain and teasing diarrhœa ; (b) to persistence of the growth in the bowel below, causing a profuse sanious discharge ; (c) to the growth extending upwards towards the wound, or to the bowel having been opened only just above the growth.

The question of the value (or otherwise) of colostomy as a preliminary to excision of the rectum will be discussed later.

(2) Temporary colostomy is sometimes advisable in some cases of late volvulus of the sigmoid with paralytic distension.

(3) Fibrous stricture of rectum or pelvic colon in which previous treatment, including dilatation, has failed, and for which proctotomy is not suitable or resection is considered too dangerous.

Much of what has been written above of colostomy for malignant disease of the rectum applies to the operation here also. There is one reason for resorting to it earlier which may occasionally arise, and that is where the patient is young, and colostomy is called for by extensive ulceration, it is possible that with the rest given by the operation the above condition may be healed, and the artificial opening closed later on.

(4) Pelvic tumours—e.g. enchondroma or sarcoma—pressing on the rectum.

(5) Results of pelvic cellulitis narrowing the rectum.

(6) Vesico-intestinal fistula.

Colostomy is performed in some cases of communication between the large intestine, especially the rectum, and the bladder, to prevent the passage of fæces into the bladder, with its results of cystitis, agonising obstruction of urine, and passage of flatus from the urethra without notice and beyond control.

Such a fistula is much more frequently met with between the sigmoid or rectum and the bladder ; if between the latter and the rectum, the communication may be found by the finger, or by passing a duck-bill speculum, or by the aid of the sigmoidoscope and injecting coloured water into the bladder. Too frequently malignant in character, it is occasionally of a simpler nature—e.g. due to pericolitis, especially that secondary to diverticulitis of the sigmoid—and so, perhaps, curable. Thus, in Mr. Holmes's case,[1] the ulceration between the sigmoid and the bladder was not malignant, colostomy for fifteen months was most successful, but a permanent cure was prevented by similar ulceration taking place between the cæcum and bladder, which caused death. Whether the cause is malignant disease or no, the life which lies before the patient is scarcely tolerable.

The opening is frequently valvular in nature—i.e. while it admits of the passage of fæces into the bladder, urine very rarely passes per anum. In some cases a radical operation is indicated for non-malignant fistula, the disease of the bowel and the opening into the bladder being treated by abdominal section.

[1] *Med.-Chir. Trans.*, vols. xlix and l.

(7) *Imperforate Rectum.* Colostomy (iliac) is usually performed on the left side in cases of malformation of the rectum, when this part of the intestine cannot be found by a dissection in the perineum. It used to be disputed in these cases whether, after an unsuccessful exploration in the perineum, an iliac or a lumbar colostomy should be performed. The great majority of surgeons have preferred the former operation, following here Mr. Curling.[1] This surgeon pointed out that the lumbar operation was contra-indicated on the following grounds : (*a*) The death-rate is relatively greater ; (*β*) the kidney, varying in size at this time of life, may, when large, overlap the colon ; (*γ*) the colon, instead of being distended with meconium, as might be expected, is sometimes contracted and very hard to find ; (*δ*) in addition to the irregularities in the position of the colon which have already been mentioned, a meso colon is frequently present.

To these reasons may be added, that an anterior incision allows a thorough exploration to be made ; recently three cases have come under my notice in which the whole of the large intestine was represented by a fibrous cord with a very minute central canal, and the ileum had to be opened.

(8) Tuberculous disease of the rectum if extensive occasionally demands a temporary colostomy ; the rest so obtained may be of great value, and the artificial anus may be closed later in some cases.

(9) Malignant disease of the colon. This is common in the sigmoid, splenic, or hepatic flexures. Colostomy may have to be performed as a temporary measure, late in intestinal obstruction. Early in obstruction, and when the growth is not too low lateral anastomosis is to be preferred. In many cases the growth can be removed later and the artificial anus closed.

(10) Severe membranous colitis and ulcerative colitis. Mr. Golding-Bird and Dr. Hale White have described three cases of membranous colitis in which right lumbar colostomy was performed, and one case of chronic dysentery in which cæcostomy was employed.[2] They have also given the more valuable subsequent histories of these cases.[3]

CASE I. Female æt. 30, of neurotic temperament, had suffered from chronic mucous and membranous colitis for ten years. The right lumbar colostomy was performed, and a spur soon formed so that no fæces entered the ascending colon. The symptoms all disappeared, and the colostomy was easily closed after five weeks ; the patient remaining quite free from symptoms of colitis until her death, two months later, from general peritonitis of uncertain origin. A small pelvic tumour existed, which may have contained pus and ruptured.

CASE II. Female æt. 36 had suffered from severe membranous colitis for twenty years. In May 1896 right lumbar colostomy was performed in two stages, and the patient improved very much in her general health, but she still passed a few casts, but otherwise she had not a bad symptom when in May 1897 the colostomy was easily closed. In November 1898 she was quite well and leading an active life, but had to take aperients. In February 1902 she had rheumatic fever, and the patient's mother, replying to an inquiry, stated that " she has to admit that there is very little change in her condition compared with that before operation, and she could not candidly say that there is a perfect cure." " The general health is very bad, occasionally swelling attacks (tympanites), great wasting of the body ; the food passes through undigested, accompanied by casts and blood occasionally. . . . There is considerable constipation." The relapse began in December 1898.

CASE III. Female æt. 31, a barmaid, had suffered from symptoms of severe colitis for eighteen months, passing much membrane. In March 1898 right lumbar

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[1] *Diseases of the Rectum*, p. 228.
[2] *Clin. Soc. Trans.*, 1896 and 1899.
[3] *Ibid.* 1902.

colostomy was performed in two stages, with an interval of five days. This gave great relief. A weak solution of lysol was injected into the colon on two occasions, but this was followed each time by a return of the symptoms, and casts were passed ; the same thing occurred in the second month, when, owing to the formation of a keloid, the wound contracted and some fæces escaped up the colon. The patient left the hospital after four months, and she was then in excellent health. It was proposed to close the artificial anus after a year, but the patient was anxious not to hurry and so run any risk of a relapse.

No difficulty was experienced in closing the artificial anus in September 1900, two and a half years after it was made.

During the two and a half years in which the fistula remained open the patient kept in perfect health, resuming her business as a barmaid six months after the artificial anus was made, and subsequently continuing her occupation without interruption. She suffered no inconvenience from the protective apparatus she wore over the opening. During the eighteen months that have now elapsed since the closure of the wound she has remained in perfect health, following her usual occupation. She was taken into Guy's Hospital in November 1901, for a short time, and all the motions were examined, and found to be perfectly natural.

CASE IV. Male æt. 35 had suffered from symptoms of chronic colitis (probably dysenteric) for seven years. In December 1898 the cæcum was opened through an inguinal incision, the bowel being first sewn to the parietes ; it did not allow of being pulled out sufficiently to pass a rod or anything else behind it ; the operation was performed in two stages with an interval of five days.

Owing mainly to the fluidity of the contents of the bowel, it was found impossible to prevent a little motion now and then passing into the colon ; but after the external opening had been somewhat enlarged, and a suitable plug fitted, fæces got more seldom into the colon ; but throughout the case up to the time of the man leaving the hospital some motion would escape that way once in two or three days. To try to prevent this, a Paul's tube was inserted into the ileo-cæcal valve, which was easily felt opposite the artificial opening in the cæcum ; it, however, did not answer, and was invariably and quickly extracted. A rubber plug attached to a shield so made as to block the ascending colon as far as possible was found to answer best. After seven weeks the patient left the hospital to return to work much improved in his general health and having lost all his symptoms of colitis.

During the summer of 1899 he worked hard as an artisan at Woolwich Arsenal and as he continued perfectly well, was anxious for an early closure of the wound. Two attempts were therefore made during 1899, but neither was successful, though the opening was much reduced in size. Since the second of these attempts very nearly all the fæces have passed naturally through the colon and rectum in a perfectly healthy way, only a little occasionally coming through the colostomy wound. A third and last attempt was made in 1901, but again with only partial success. But on February 25, 1902, he presented himself in good health, and reported that the small sinus resulting from the last operation had closed by itself. It will be noticed that he has remained well for two and a half years after the passage of fæces along the colon has been re-established.

Other cases may be very briefly mentioned.

CASE V. Messrs. Keith and Simpson[1] publish an account of an apparently right colostomy performed in June 1894 on a woman æt. 34, with four years' history of membranous colitis. The wound was kept open for seven months and then closed. A perfect cure is recorded.

CASE VI. Dr. Lawrie, of Weymouth.[2] The patient was 47, and had a history of membranous colitis for eleven years. Cæcostomy was performed in January 1897. The report says that the cæcum was able to be drawn out of the wound and a rod to be passed through its mesentery. The wound was kept open seven months. The last note of this case is in February 1898, and a cure is claimed.

V. Curl mentions several cases of moderately severe dysentery treated by cæcostomy with hopeful results.[3]

It may be concluded from these cases and others, that right colostomy may be beneficial in the treatment of severe chronic colitis, especially

[1] *Med. Press*, July 24, 1896 (quoted *Clin. Soc. Trans.*, 1899).
[2] *Brit. Med. Journ.*, November 5, 1898.
[3] *Ann. of Surg.*, 1906, vol. xliii, p. 543.

ulcerative colitis, and that the operation is better than cæcostomy because the diseased colon is granted a more complete rest ; the discharges are more solid and less frequent owing to the absorption of fluid in the cæcum. The skin around the fistula is less apt to get inflamed.

The absorption of water and some nourishment in the cæcum is a distinct gain in feeble patients. Mr. Golding-Bird believes that complete rest to the colon is more valuable than irrigation. The time of closure must not be too early, certainly not under six months, and probably not under a year in most cases.

Mr. Golding-Bird considers that colostomy is preferable to ileo-sigmoidostomy in these cases for several reasons : the anastomosis may not be below the disease, which may extend to the pelvic colon in some cases, and the fæces in time regurgitate into the diseased colon above and set up more trouble. The other alternatives of treatment are valvular cæcostomy and appendicostomy with irrigation, which are discussed later on (see p. 267).

The Site of the Proposed Colostomy. In the above cases, especially where intestinal obstruction is threatening from malignant disease with distension and tympanites, the surgeon, particularly if the history is deficient or misleading, may be in doubt as to the site of the disease, and therefore where to operate. The following points will help in doubtful cases. Before specifying them I would call attention to two points : one, that malignant disease quite low down, e.g. in the sigmoid, may, by a sudden onset of obstruction, simulate an acuter condition higher up, the patient being too ill, or otherwise unable, to give an account of previous threatening and finally culminating obstructions. Here the following alternatives lie before the surgeon : (1) To find the site of obstruction through one rectus near the middle line : this is by far the best method. (2) To cut down upon the sigmoid flexure in the hope that the obstruction may be in this neighbourhood, a very common place, and if the sigmoid be found empty to enlarge the incision sufficiently to allow the hand to be introduced for exploration ; it is not easy, however, to explore the whole distended abdomen from this region, moreover another incision may have to be made to open the colon on the right side unless ileo-sigmoidostomy is preferred ; (3) to perform right colostomy, so as to make sure of relieving any obstruction further back—e.g. in the splenic or hepatic flexures. Unless it is certain that the obstruction is in the colon, this course is not recommended, for the ascending colon may be found to be empty, as in a patient who was later found to have a gall-stone in the ileum. In all doubtful cases it is better to make the incision near the middle line, so that a thorough exploration can be made. I would here warn my junior readers on two or three points. If they decide first to explore by abdominal section, and find a growth in the colon, descending or ascending, they should not, even if the mesocolon admits of it, bring the bowel into the middle line and open it. Making an artificial anus in the colon by a median incision is usually a matter of difficulty, the bowel not coming sufficiently up into the wound (this does not apply to the transverse colon), thus the skin has to be forced down to it, causing tension on the sutures, giving way of these a little later, and either disastrous results or a most unsatisfactory opening. Even if it were usually easy to carry out the above course, I do not consider it would be good surgery, as such

displacement of the large intestine may lead to acute obstruction of some loop of the small intestine later on.

I also strongly advise against opening the cæcum if this can be avoided. Owing to the more liquid nature of the fæces here from the close proximity of the small intestine, though the patient's nutrition will not suffer, the skin in the neighbourhood of the artificial anus is liable to most troublesome excoriations and ulceration.

In cases where the surgeon is in doubt as to the exact site of the disease, but suspects from the age of his patient, duration of the trouble, history of "indigestion" with unsatisfactory action of the bowels, number of attacks of threatening obstruction, &c., that the mischief is somewhere in the large intestine, attention to some of the following points may be useful :

(1) The proportionate *frequency of stricture in different parts of the large intestine.* The frequency of disease in the rectum and sigmoid flexure, as compared with any other part of the large intestine, and, generally speaking, the frequency of disease in the left side of the arch formed by the large intestine, as compared with such disease in the right side, are well known.[1]

(2) *Examination of the rectum.* It must be remembered that a growth in the rectum may not be discovered by the usual digital examination made with the patient lying down, whereas it may be felt when the patient is in the sitting attitude and straining ; this brings more than another inch of rectum accessible to the finger, and when an annular growth exists high up, it often becomes intussuscepted into the ballooned rectum below, and may be felt when the patient is straining. Occasionally also a growth of the pelvic loop of the sigmoid flexure may be felt through the anterior wall of the rectum. The sigmoidoscope may reveal a growth in the upper part of the rectum or the lower part of the sigmoid colon.

(3) *The form of the abdomen* may help to valuable conclusions. Thus, Dr. Fagge [2] gives a case of cancer of the hepatic flexure in which it was observed during life that the cæcum and ascending colon were distended, and not the descending colon. Again, he observes that when the rectum or the sigmoid flexure is the seat of obstruction the lumbar regions and the epigastrium are no doubt generally prominent, and the course of the colon is more or less plainly marked out. That these conclusions are only valuable if not too implicitly relied upon is shown by the fact that cancer of the rectum may be present, with vomiting, peristalsis, and borborygmi, and yet there may be no general distension of the abdomen, no filling out of its sides ; on the other hand, a prominent epigastrium, and the appearance of a large horizontal coil of intestine here, may lead to the conclusion that the transverse colon is distended, the disease being, nevertheless, in the small intestine, a distended coil of which has rivalled the colon itself.

A patient observation of the abdomen for peristalsis, which may be stimulated by flicking the abdominal wall with a wet cold towel, may sometimes enable the surgeon to localise the site of the obstruction almost accurately.

[1] Dr. Fagge, in drawing attention to this fact (*Guy's Hospital Reports*, 1868, p. 314), quoted the following statistics from Dr. Brinton : " Of 100 cases, 4 are in the cæcum, 10 in the ascending colon, 11 in the transverse colon, 14 in the descending colon, 30 in the sigmoid flexure, and 30 in the rectum." The statistics of Dr. Fagge and M. Duchaussoy confirm the above. [2] *Loc. supra cit.,* p. 319.

(4) A symptom of some value, if verified by the medical man himself, is the fact that for some time the *motions* have been *narrow, tape-like, broken up, abnormal in bulk, shape, and length.* This symptom generally points to a growth in the rectum or sigmoid. Certain fallacies diminish, however, the value of the above, *e.g.* that in cases of stricture high up, as in the upper part of the sigmoid flexure, there is probably room for the fæces, after they have got through the stricture, to collect, till their characteristic form is given them, though we do not know how far irritation of the intestine and formation of mucus at the seat of the growth may interfere with this.

(5) *The frequent passing of " blood and slime "* also generally indicates a growth low down in the large intestine. When the symptom is only terminal in a case of chronic obstruction it probably means that the growth has become intussuscepted ; in a recent case this sign, associated with pain, tenderness, and dulness in the left flank, enabled the writer to conclude that an intussusception of a growth at the splenic flexure had occurred.

(6) A few other points—*e.g.* constant *arrest of borborygmi at one spot, fixed pain at one spot,* as in the right hypochondrium—may give useful indications. The use of large injections is mentioned only to be condemned as unreliable and dangerous. It is unreliable because some of the fluid may pass through the stricture, and it is dangerous for the same reason, for the distended colon, especially the cæcum, may be ruptured from the increased distension of the intestine, often the subject of " distension ulcers." Moreover, it is painful and wastes precious time.

The distance to which a long bougie or rectal tube passes is of very little value, and needs only the briefest mention here because the surgeon is still sometimes called to cases in which he is assured that the obstruction cannot be in the rectum or low down in the sigmoid flexure, as a long bougie has been easily passed its full length. This fallacy, which is due to the bougie bending on itself, is more frequent than the other one in which the arrest of a bougie by one of Houston's folds misleads into the belief that a stricture exists low down. The sigmoidoscope is far more reliable, and it is practically safe when carefully passed with the aid of its lamp, and distension with air. If, after weighing the above, the surgeon is still in doubt as to the exact site of the disease of the large intestine, he should not hesitate to open the abdomen near the middle line and explore for the site of the disease, and then to decide on the line of treatment to be adopted.

INGUINAL OR ILIAC COLOSTOMY

This operation has replaced lumbar colostomy because the iliac operation has the following advantages : (i) It is easier. Thus (*a*) the patient, being on his back, takes the anæsthetic better than when rolled on his side ; (*β*) in a stout patient, especially, the soft parts are easier to divide, and the resulting wound less deep and more readily dealt with than one in the loin ; (*γ*) the bowel is more easily reached, and with less disturbance of deep-lying soft parts ; (*δ*) there is no risk of opening small intestine, or of failing through abnormality of the colon. (ii) The peritoneum being opened of set purpose, the surgeon can explore the abdomen, examine the site and extent of the disease. (iii) The shallower wound makes it much easier

to draw out the intestine, and make a satisfactory angle and spur, or to perform colectomy. (iv) The position of the anus renders it more easily accessible for the needful attention.

Where the colon is distended, the lumbar operation is an easy one ; but where the bowel is flaccid and lies deeply far away in a fat patient, the operation is one of the most difficult in all surgery. The second advantage claimed—that an iliac colostomy enables the surgeon, by opening the peritoneal cavity, to examine into the site and extent of the disease—will be found an important one, for the surgeon can decide for or against the possibility of the removal of the growth at a second operation, or he may be able to bring the growth outside the abdomen and excise it some days later when the patient has recovered from the intestinal obstruction. The third advantage is an important one in those cases where a deep wound loaded with fat makes it very difficult to bring up and anchor a lumbar colon satisfactorily. On the fourth point, on which much stress has been laid—that an artificial anus in front is placed more satisfactorily for the patient's needs than one in the lumbar region—there is something to be said on both sides. A patient with an artificial anus in front can clean this, adjust the pad, and wash out the bowel below far more comfortably. If the motions have been allowed to become constipated, and, in order to get relief, assistance must be given from without—a very real difficulty sometimes, and one requiring considerable time and attention on the patient's part —this can be done very much more easily with an anus in the iliac region. On the other hand, the passage of flatus or the effluvium of a suddenly escaped motion will be greater annoyances with an anus placed in front. And it is obvious that in some conditions of daily life a lumbar opening may be very superior to one in front.

Peritonitis is more likely to follow the anterior operation, but with asepsis and care not to rupture distended bowel by rough handling, there is not much risk of this. Cellulitis of the loin used to follow lumbar colostomy occasionally.

Prolapse of the bowel and hernia are more common after the anterior operation. Of this there can be no doubt whatever. It must be so, on anatomical grounds, viz. the far greater mobility of the sigmoid colon, the greater laxity of the soft parts in the groin as compared with those in the loin, where we have the lumbar fascia, psoas, and kidney. These points, together with the fact that in walking, standing, and sitting the small intestines must necessarily tend to push upon and protrude an inguinal artificial anus, all explain why prolapsus after inguinal is so much more marked than after lumbar colostomy. This result, if the prolapsus be a large one, causes great discomfort to the patient, the projecting, moist, readily bleeding mass in the groin interfering much with cleanliness and locomotion. While the precautions given later will serve to diminish the amount of prolapsus, this will always give more trouble here than in the lumbar region : a tendency to large prolapsus there is quite exceptional ; with iliac colostomy it is common. On the other hand, an artificial anus, as opposed to a fæcal fistula, is much more easily secured after an iliac colostomy.

Operation. An incision two and a half inches long is made with its centre at the middle of the line joining the left anterior superior spine and the umbilicus. There are three points here of the greatest importance from their bearing on the chief drawback of this operation, prolapsus. Mr.

Cripps [1] finds that by making his opening in the abdominal wall somewhat higher than in his earlier cases, there is much less tendency to protrusion. He now makes his " incision nearly as high as the level of the umbilicus, so that the wall of the lower part of the abdomen, where the pressure is greatest, is left intact." Another point to be insisted on is that, wherever the opening is made, it should be as small as possible. The freer the incision, the weaker the abdominal wall—already naturally weak here—and the more certain is a large prolapsus to follow. In an ordinary case of iliac colostomy for rectal cancer, the operator should endeavour to find the sigmoid with an opening admitting one finger to explore deeply, if need be, as far as the pelvic brim, and hook up the sigmoid. Lastly, it is an advantage to use the " gridiron " or valvular incision similar to that which McBurney introduced for the removal of the appendix. The risk of prolapse is much diminished, and the control obtained over the artificial anus is greater. Carwardine [2] cuts across the fibres of the external oblique aponeurosis, making his skin incision also in the direction of the muscular fibres of the internal oblique and transversalis. He states that he thus avoids the contraction of the orifice that is liable to occur if the tendinous fibres are merely separated. When the incision is placed as high as advised above, the tendinous fibres of the external oblique are not seen. More œdema of the prolapsed loop is apt to occur when muscular separation is adopted instead of division of the muscular fibres, but this soon passes off. Some surgeons believe more control is obtained by making the incision through the outer third of the left rectus, the muscular fibres of which are separated. The layers of the abdominal wall having been separated, and all hæmorrhage arrested, the peritoneum is then raised, and slit up with scissors for about two-thirds of the wound already existing. It is not necessary to sew the parietal peritoneum to the skin, and this step increases the tendency to prolapse. The intestine rapidly adheres to the muscular wound. The sigmoid or the omentum or small intestine may be seen in the wound. If either of the two latter present (and the omentum may do so very persistently), they are returned, and the colon is sought for with the finger. It is usually close at hand, and may be recognised by the scybala which it contains, or by its appendices epiploicæ and longitudinal muscular bands, which are not always obvious, however. In difficult cases the bowel will be found by searching in the iliac fossa, the finger being passed along the parietal peritoneum from without inwards, until the sigmoid is encountered attached to the posterior wall ; this is the best method. Failing this, the descending colon may be traced down from the kidney. It is well to remember that anterior colostomy is not always the easy operation, as regards finding the bowel, that it is represented to be. (Mr. Cripps speaks [3] of occasionally having had great difficulty in finding the bowel.

In one case, after a long search, he was unable to find the bowel ; the nurse being directed to give an injection of water, the finger near the brim of the pelvis then felt a piece of intestine, which had before been overlooked, becoming distended, and the sigmoid, which was lying almost over in the right iliac region, was thus detected. In these cases of difficulty Mr. Cripps thinks that the colon will almost invariably be found nearer the middle line of the abdomen than where the operator has been searching.

[1] " Complications arising in Inguinal Colostomy," *Brit. Med. Journ.*, October 19, 1895.
[2] *Pract.*, vol. 74, 1905, p. 179.
[3] *Loc. supra cit.*

In a case of Mr. Cooper's, reported by Dr. Pennington, of Chicago,[1] the operator having failed to find the sigmoid, water was injected into the rectum, and was noticed to pass into the right iliac fossa. The opening in the left side being closed, an incision was made in the right inguinal region, where the gut—presumably the misplaced sigmoid—was readily found. The patient made a good recovery.)

In some cases, the wound may have to be enlarged by prolonging the separation of the two deep muscles inward, opening the rectus sheath, and drawing the rectus inwards; then the large intestine may be traced upwards from the rectum, if necessary.

The bowel being found, a loop of it is drawn up into the wound. To avoid the prolapse which is certain to occur if loose folds of the sigmoid remain immediately above the opening, the surgeon gently draws out as much loose bowel as will readily come, passing it in again at the lower angle as it is drawn out from above. In this way, after an amount
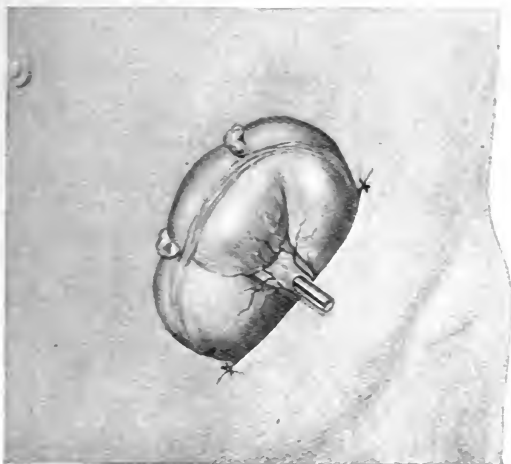
FIG. 143. Inguinal colostomy. A rod is passed through a bloodless part of the mesocolon and well away from the bowel.

varying from one to several inches has been passed through the fingers, no more will come. As soon as the descending colon is found in this way to be nearly taut, a pair of forceps is pushed through the meso-sigmoid about a quarter of an inch from its attachment to the bowel, and a straight piece of sterilised gum-elastic catheter No. 10 or 12 caught in the forceps and drawn through; or a glass rod or a vulcanite one suitably pointed at one end may be preferred. The angles of the wound are closed with fishing-gut sutures (see Fig. 143). The wound is dressed with gauze or sterile pads arranged all around the bowel so that the latter is in a kind of box and is not liable to be damaged by the firm pressure that must be maintained to prevent protrusion of more bowel through the wound during vomiting. This danger can be avoided by applying a broad band of strapping firmly all round the body outside the dressings (Davies-Colley). The bowel may be opened by a transverse incision on the second day.[2] No anæsthetic need be given; if the patient is

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[1] *Journ. Amer. Med. Assoc.*, 1893, vol. ii, p. 773.

[2] Vomiting and distension of the abdomen are indications for opening the bowel earlier; it is safe to do so if necessary after twelve hours.

nervous, a 2 per cent. solution of cocaine may be applied. The opening is made with the cautery to avoid bleeding. A few days later all the bowel that projects above the skin is cut away with scissors; all bleeding points are tied or cauterised.

In some cases a loop of colon cannot be drawn out of the wound until it has been mobilised by blunt dissection after incising the parietal peritoneum parallel to and about an inch to the outer side of the colon. It is better to do this than to try to suture distended friable bowel to the parietal peritoneum, for during coughing the bowel may be torn away from its attachment, causing extravasation of fæces into the peritoneum.
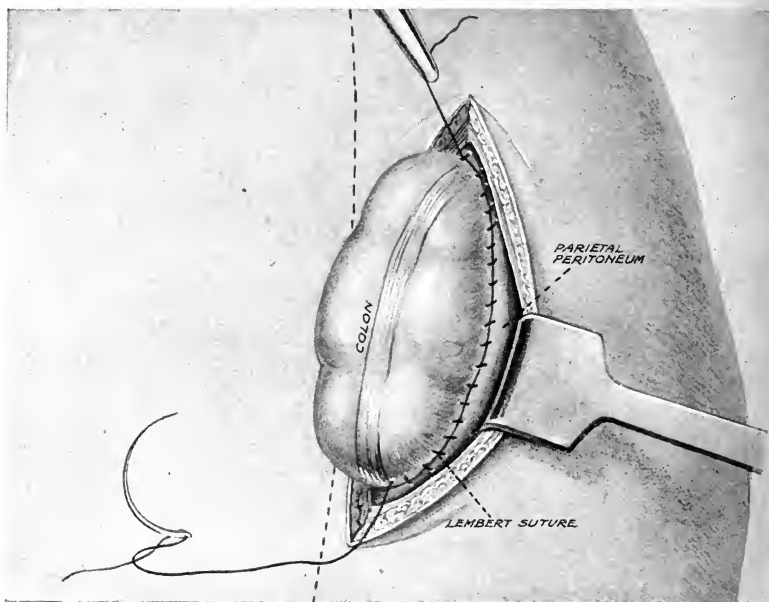
Fig. 144. Inguinal colostomy. Paul's method of sewing a lateral pouch of the iliac colon in the wound which is from $1\frac{1}{2}$ to 2 inches long, and is external to the rectus.

All sutures should be removed by the tenth day, or earlier if any redness is present.

When the projecting loop has been pared down, as advised above, two openings will be seen separated by an efficient spur. Through the lower of these the rectum can be washed out, and the removal of any fæces lying above the disease facilitated. Gradually, usually in about a month, the patients begin to acquire some control over their artificial opening, but it will not be till several months after the operation that they can be said to become comfortable in this respect, and acquire satisfactory control over, and management of, their artificial anus. And for the rest of their life discharge of blood and slime may occur from the anus. This must be met by astringent injections and suppositories. Diarrhœa must be treated by strict attention to diet, and by astringents; escape of offensive flatus or fæces from the artificial anus may be met by the use of charcoal, a teaspoonful being given twice

a day, or the following may be taken twice a day in a capsule or cachet, viz. betol, salol, salicylate of bismuth, of each gr. v.[1]

Mr. Paul[2] does not wish to make a spur, and does not bring so much of the bowel out, but fixes it to the parietal peritoneum with a continuous sero-muscular suture of catgut (Fig. 144). He clamps the projecting pouch, opens it at once, and sews it to the skin with a continuous button-hole suture of catgut (*see* Fig. 145).
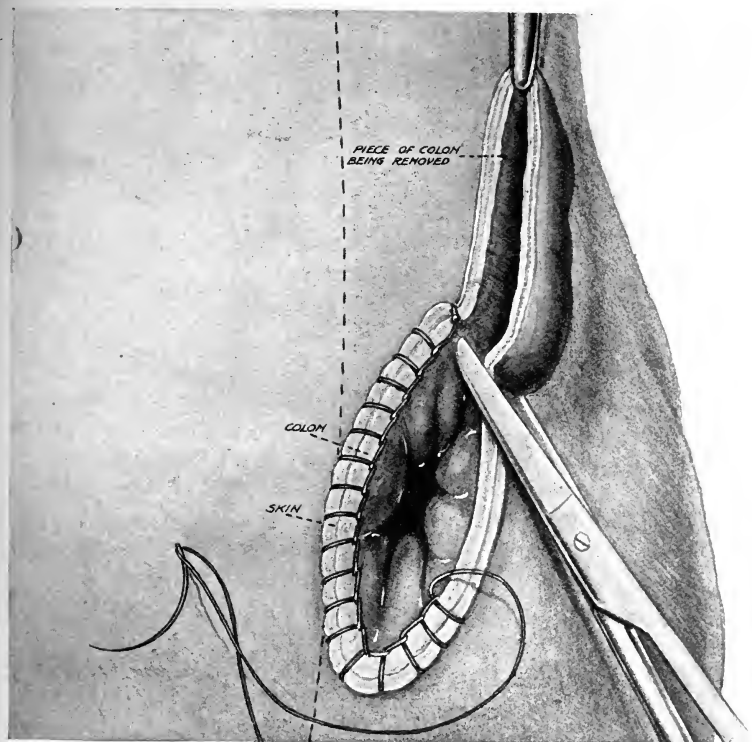
FIG. 145. Inguinal colostomy. Paul's method of immediately opening the colon and sewing the edges to the skin. The opening is only 1 to 1¼ inches in diameter.

Where obstruction is present, the bowels much distended, and the sigmoid requires immediate opening, additional care must be taken in handling the intestines and in preventing any escape of fæcal fluid or gas into the peritoneal cavity. Aseptic gauze is wrapped round the base of the loop of bowel and under any supporting rod, protecting the line of suture and peritoneum.

A portion of the bowel is emptied and gently clamped, while a small Paul's tube is introduced without contaminating the wound (*see* Figs. 146 and 147).

The objection which has been raised to the method, namely, that sloughing and loosening of the tube take place too rapidly, may be met by using a small tube and by fixing it with a purse-string suture piercing all the coats close to the edge of the incision in the bowel.

[1] Mr. C. Heath, *Brit. Med. Journ.*, vol. i, 1892, p. 1243.
[2] *Lancet,* 1912, ii, p. 222.

Carwardine's enterostomy tube (*see* Fig. 148) [1] may be used; this is more expensive but more secure than a Paul's tube, and it does not become detached so soon.

Greig Smith's method of fixing a long rubber tube in the intestine is very simple and nearly always practicable. Two side holes are made
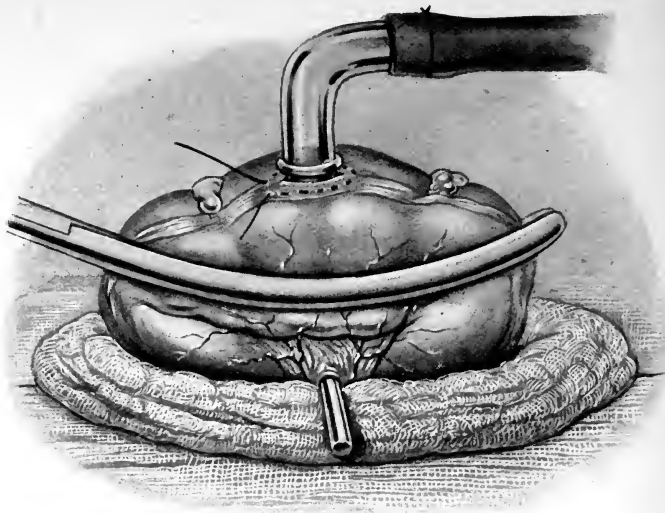
Fig. 146. Inguinal colostomy. The parietal wound is protected by gauze wrapped round the loop of bowel beneath the rod. The colon is clamped while a Paul's tube is inserted and firmly secured with a purse-string suture piercing all the coats.

near its end which should be passed into the distended colon within the abdomen, so as to ensure good drainage.

Lilienthal's [2] visceral evacuator prevents leakage, but is somewhat complicated, large and rigid for use in colostomy. It is likely to be of more value for the temporary drainage of distended intestine during an operation for the relief of acute obstruction by a removable cause like a band.
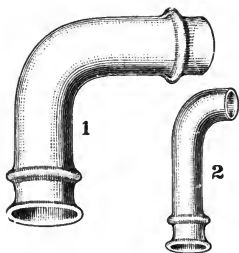
Fig. 147. Paul's glass tubes, large and small. The lower end is tied in, the upper receives the drainage-tube.

Madelung's Modification of Colostomy. This has been largely used, both in the lumbar and inguinal operation, abroad. In this country it has not found favour. It consists in drawing out the bowel sufficiently, packing the wound with small sponges attached to silk, while the loop of intestine (which, if full, should be emptied as far as possible by squeezing its contents upwards) is packed around with gauze. The intestine being clamped is next cut across. The clamp is then removed from the lower end, which is emptied, cleansed, and closed by careful suturing, viz. one continuous, and then others by Lembert's method, causing efficient inversion of the sutured extremity. This end is then dropped back into the peritoneal

Loc. cit.   [2] *Ann. of Surg.*, January 1906.

cavity. The upper end is now fixed in the wound, or is drained by tying a glass tube in it to which india-rubber is attached.[1]

The above method has never been much used in this country, for the following reasons :

(1) The great advantage which it claims, of preventing the passage of fæces into the lower part of the bowel, may be secured by much simpler
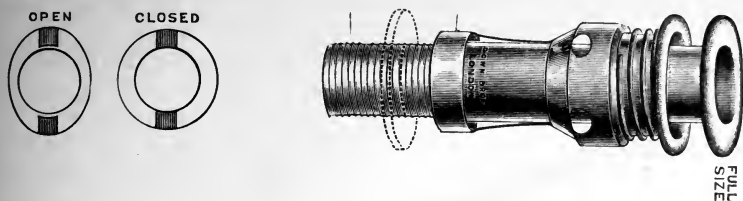
Fig. 148. Carwardine's self-retaining tube.

means, viz. pulling out the bowel sufficiently to get an efficient spur and cutting away the intestine afterwards.

(2) It has inherent grave objections :

(a) It has happened again and again that when the mesentery is long the sigmoid has, unknown to the operator, become twisted, and thus, when it is drawn up into the wound, the upper instead of the lower end may be closed and returned. In such a case fæcal extravasation through the sutures into the peritoneal cavity must occur. Mr. H. Allingham stated [2] that in seven of his inguinal colostomies the gut must have been thus " twisted," as fæces came away through the lower of the two openings. He stated that he knew of a fatal termination from this cause in several cases in which Madelung's operation had been adopted. Mr. Cripps [3] has met with two cases in which what he believed to be the lower end of the bowel eventually proved to be the upper. Dr. Landon, of Göttingen,[4] has explained the above fact by a necropsy.

In two cases of inguinal colostomy in the Göttingen clinic, where the usual practice is to divide the gut and to stitch the two open ends in the wound, it was noticed that fæces always discharged from the lower and not from the upper opening, although at the operation the lower part of the intestine had been traced towards the bladder, and the upper in the reverse direction. In one of these cases, which terminated fatally, the necropsy showed that the sigmoid, which was very long and freely movable, passed upwards and outwards as far as the splenic flexure of the colon, and then curved downwards and towards the middle line, reaching the rectum after a long and tortuous course.

(b) The lower end of the bowel, whatever precautions are taken before the operation, will contain some fæces above the site of the cancer : if the lower end of the bowel be sutured, these fæces must cause irritation and increased discharge ; if they be scybalous, and the bowel above the stricture thinned, as it often is, they may bring about fatal ulceration. (c) Closing the lower end prevents any attempt at washing out the bowel by syringing through from the colostomy opening to the anus or vice versâ, and so diminishing the constant tendency to sanious mucous discharge, which, if left to collect above the cancer, hastens its growth and promotes its sloughing. (d) It adds to the severity of an operation in patients who, from their present and in view of their future, need careful handling. This is true of inguinal

[1] Brit. Med. Journ., 1891, vol. ii, p. 118.
[2] Ibid. p. 337.   [3] Ibid. p. 447.
[3] Centr. f. Chir., Bd. xxx, 1891.

colostomies when the bowel is empty. If it be distended, severing the bowel adds greatly to the difficulties of what is now a trying operation, and increases the risks of contamination of the peritoneum.

This modification of Madelung's is, I think, only justifiable when colostomy is performed previously to removal of part of the rectum: even under these circumstances I think it may be harmful, by preventing the washing out of the intervening bowel which may add so much to the comfort of the patient. Any surgeon about to divide the bowel should make certain of the lower end by tracing the bowel down to the growth or rectum. The latter may be more certainly identified after an assistant has passed a bougie into it from the anus.

Hartwell,[1] in performing colostomy as a preliminary to excision of the rectum, brings the sigmoid into the wound through a gridiron incision at the level of the left anterior superior spine; he divides the clamped bowel across at a distance of about twelve inches from the anus. The distal end is then fixed at the lower angle of the wound. The proximal end is protected by gauze and drawn upwards and inwards between the rectus muscle and its anterior sheath and secured in a median vertical incision near the middle line. Care is taken not to damage the vessels of the meso-sigmoid during this manoeuvre; the mesentery is only slit enough to allow the intestine to come into the median wound without tension. Hartwell claims that this method gives the patient more control than any other. It seems to me unnecessarily severe, and moreover it is not practicable without gravely increasing the risk where the sigmoid is distended and friable in obstructive cases.

Marro[2] sterilises the open end of the colon and passes it through a subcutaneous tunnel over the rectus muscle, where it can be compressed by a belt.

Lilienthal[3] twists the end of the bowel and thus creates a valvular opening.

If the artificial anus contract unduly, it must be dilated with laminaria tents and the patient's finger. Mr. Cripps has introduced a spring dilator which is self-retaining, and which can be worn for four or five hours daily. That this complication is one to be watched for is plain from this passage in Mr. Cripps's experience:[4] "This is not an uncommon sequence, and, if allowed, will destroy the whole advantage of the operation. Too small an opening means a constant dribbling of faecal matter, the motions never getting freely and completely away. These contractions do not occur where the original opening has been made of proper size, and where all the wound has healed by first intention, but occur where the angles of the wound have failed primarily to unite, and where the granulations gradually become converted into firm contractile tissue. If the angles have not united properly, the contraction will begin about the third week; and if at this time a little spring dilator be introduced and worn for a few hours daily for a month, the tendency to undue contraction will be obviated. If this precaution has been neglected, or be impracticable, the opening can readily be made the right size by passing the finger into the bowel, and then completely cutting through all the contractile tissue up to each angle, the depth of the cut exposing the wall of the bowel. The bowel is now freed a little on either side of the incision, and a curved needle and silk thread is

passed through its edge, and through the tissues and skin at the apex of the reopened wound. This suture is tied, bringing the gut well up to the angle. A couple of additional sutures may be necessary at the sides."

Colostomy Appliances. Until the patient has gained some control over the artificial anus, or has learnt how to manage it, a dressing of lint smeared with some simple ointment and changed as often as may be necessary is the best for the patient. Later some form of belt may be fitted; this gives more general support and keeps in position better than a spring truss. Rubber belts sag and rarely fit. Plugs if hollow collapse and turn sideways; if made of rubber they soon perish. Mr. Paul recommends "a simple mushroom-shaped aluminium plug, retained in position by a pad of wool and a detached belt."

Complications and Difficulties in Inguinal Colostomy. (1) Difficulty in finding the bowel. This has been fully entered into at p. 254.
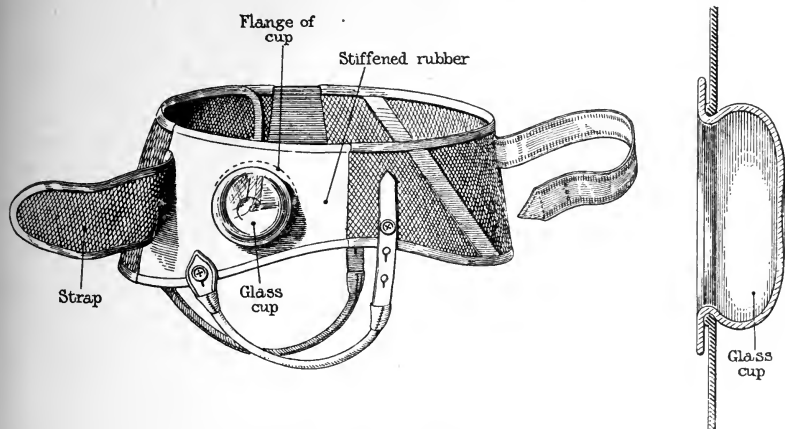
Fɪɢ. 149. Colostomy belt. (Pengelley, Bailey and Co.)

(2) Absence or shortness of mesentery. I will here quote Mr. Cripps:[1] "This is perhaps the most unfortunate and ·dangerous complication that can be met with, and to this cause, with one exception, I owe all my fatal cases. In the great majority of cases the mesentery of the sigmoid flexure is amply sufficient to allow of the bowel being well drawn up in the wound, and safely fixed without tension; but in 3 or 4 per cent. this is not so, for there is absolutely no mesentery, the bowel being bound firmly back against the posterior parietes. This is either due to congenital deficiency, or to malignant disease behind the colon fixing it firmly. The question to be considered is as to what should be done after the surgeon has opened the abdomen and met with one of these cases. I am confident, from my unfortunate experience, that any endeavour to invert the skin and forcibly drag it down to the bowel by the sutures is a fatal mistake. The sutures will certainly cut through, leaving an open peritoneal cavity." The surgeon should avoid mistaking the fixed descending colon for the sigmoid by tracing the bowel down into the pelvis, where he may discover a pendulous and mobile loop of sigmoid which should be brought into the wound and opened if the obstruction be below it. If the mesentery is really too short, the

difficulty can be overcome by incising the parietal peritoneum parallel to and an inch external to the colon, and then mobilising the colon to the necessary extent by gauze dissection. All the vessels of the colon reach it at its mesial border. They are always long enough to allow the mobilised colon to be brought out of the wound without tension. (3) Prolapsus. The frequency of this after the operation has been explained at p. 254. It may be met (*a*) by making the wound as high up as possible (p. 254); (*b*) drawing down the intestine till the upper end is tight (Cripps), and then bringing it out through as small and valvular an opening as possible; (*c*) closing this opening round the bowel as securely as possible, whether a rod (p. 255) has been used or no; (*d*) keeping the patient at rest until the parts have had full time to consolidate; (*e*) treating assiduously any such causes as constipation, coughing, straining in micturition, &c.; (*f*) trying the effect, as early as may be, of a light spring truss and pad. The two following complications may occur during vomiting or coughing. (4) Small intestine or omentum may escape between the piece of sigmoid which has been drawn out and the edges of the wound. This accident may be known by the urgent vomiting, pain, collapse, and soakage of serum into the dressings, which should of course be removed at once, the small intestine cleansed and returned, and the wound made safe by additional sutures. This accident is most likely to occur when a large wound has been made, an insufficient number of sutures used, or sufficient support has not been provided by means of a belt of strapping (p. 255). Where omentum protrudes—a much rarer complication—it may be left, as it will all shrivel away gradually, but additional sutures should be inserted at once. (5) A rarer accident, of which Mr. Cripps has published an instance,[1] is where the bowel tears away from its attachments and falls back into the peritoneal cavity. This happened on the seventh day during a violent fit of coughing.

" The released bowel discharged a considerable motion into the peritoneal cavity. Fortunately, I saw the case about an hour after the accident. The fæcal matter was thoroughly washed out from the abdomen, and the detached bowel restitched. The patient recovered." [2]

This accident is not likely to happen when the abdominal wound is valvular, and a loop of bowel is brought out of the wound, and held in position by a rod passed through the mesentery. It has occurred when the bowel has only been held up to parietal peritoneum by sutures, which are apt to tear out of the friable intestinal wall.

(6) Strangulation of small intestine between the attached sigmoid and the parietes. An instance of this very rare accident will be found recorded by Mr. Cripps.[3]

A patient on whom inguinal colostomy had been performed was about to leave the hospital when he was seized with symptoms of acute obstruction, the pain being referred to the colostomy opening. After vomiting three or four times the patient said he felt something slip in his inside; the vomiting ceased, and the pain suddenly left him. A few days after, feeling quite well, he was discharged from the hospital, and was readmitted ten days afterwards in a dying condition. The necropsy

[1] *Brit. Med. Journ.*, vol. ii, 1895, p. 967.
[2] Mr. C. Heath's remarks on this or a similar case (*Brit. Med. Journ.*, vol. i, 1892, p. 1243) are worth the attention of any one inclined to think lightly of such an accident because the patient recovered. " Of course we hear of one case that did recover, but we do not hear of the ninety-and-nine cases which did not." The writer remembers a similar case, which terminated fatally although the peritoneum was cleansed within a couple of hours.   [3] *Loc. supra cit.*, p. 967.

showed that a loop of small intestine had slipped down into a canal, about an inch long, between the attached portion of the gut and the reflexion of the parietal peritoneum, near the anterior superior spine. From this canal the intestine must have released itself at the first attack. Mr. Cripps adds that prompt abdominal section would have saved this patient.

Causes of Death after Colostomy. (1) Exhaustion, especially if the operation has been deferred too long.

(2) Toxic conditions due to the continued distension of the intestines and the resulting absorption of poisonous material.

(3) Peritonitis. This may be due to the operation directly. More commonly it is due to the want of it at an early stage. Thus the distended bowel may have given way above the obstruction. Often it is that weak spot, the cæcum, which is found perforated or gangrenous after the stress of distension.

(4) Vomiting. This has been noticed in a few cases to recur obstinately and fatally after colostomy. It is chiefly due to paralytic distension of the lower part of the intestine while the upper part is still active and causes regurgitation of its fæcal contents into the stomach. Washing out the stomach, if done early and often enough, often saves these patients.

(5) Pulmonary complications, especially broncho-pneumonia.

CÆCOSTOMY

This operation is but rarely made use of. One objection to it is that, owing to the proximity of the small intestines, the intestinal contents are likely to be more liquid, and thus to cause more trouble afterwards. It may be resorted to under such conditions as the following :

(1) In cases of acute following upon a chronic obstruction of the ascending colon, it may be employed as a temporary measure to save the patient from his urgent danger ; later the growth may be removed and still later the cæcostomy may be closed.[1] If during an exploration in the middle line the growth in such a case is found to be irremovable, it is better to perform ileo-sigmoidostomy in order to avoid a permanent and very troublesome fæcal fistula.

(2) In certain cases of volvulus of the cæcum, in which the bowel is replaced, yet greatly distended and damaged, a temporary cæcostomy may be wisely done, and this may serve to fix the viscus and thus to prevent recurrence.

(3) As a temporary measure a valvular cæcostomy may be made for irrigation of the large intestine, in some cases of colitis or dysentery. Whenever practicable appendicostomy is preferable.

A permanent cæcostomy is very objectionable on account of the frequent and irritating discharges, which often induce very troublesome inflammation and even ulceration of the skin of the abdomen.

In some of the above instances the primary incision will be over the cæcum, and when the surgeon has been exploring the site of an obstruction through an incision near the middle line, and determines to open the cæcum, it is safer to do this through a second incision in the right iliac region.

Operation. In some cases the surgeon may experience considerable difficulty in getting the cæcum satisfactorily into the wound from congenital or acquired adhesions to the iliac fossa.

[1] Carwardine, *Pract.*, 1905. vol. lxxiv. p. 179.

The cæcum is exposed through the " gridiron " incision used for removing the appendix. A part of the anterior wall or lower pole of the cæcum is then fixed to the parietal peritoneum by a circle of continuous catgut suture. If immediate drainage be imperative one of the enterostomy tubes described on p. 258 is then introduced. When the operation is performed for colitis, there is no need to open the bowel at once, and an incision may be made into the cæcum after the lapse of twenty-four or forty-eight hours, when peritoneal adhesions will have formed. Curl[1] employs this method for the treatment of dysentery by irrigation. He prevents closure of the muscular wound by anchoring the cæcum by silk sutures to the four corners formed where the oblique muscles decussate.

Gibson[2] recommends the application of Kader's method of gastrostomy for making a valvular opening into the cæcum for the treatment of various forms of chronic colitis by irrigation. Little or no leakage occurs after this operation, and the fistula soon closes on withdrawing the catheter.

RIGHT ILIAC COLOSTOMY

Indications. (1) *Severe Degrees of Ulcerative, Dysenteric, or Membranous Colitis.* When these conditions are severe it is necessary to give the colon entire rest by draining all the fæces away through an artificial anus in the ascending colon. It is not possible to do this with a cæcostomy. (2) Occasionally for intestinal obstruction about the hepatic flexure, but as a rule it is better to perform ileo-colostomy. In suitable cases the growth can be removed later.

Operation. The steps of the operation are very much the same as those already described under left iliac colostomy (p. 252), but owing to the usual absence of a right mesocolon, the bowel cannot be brought out of the wound for the formation of an efficient spur without first mobilising the colon. This is easily done after incising the parietal peritoneum parallel to and about an inch external to the ascending colon. A little gauze dissection then allows the colon to swing forwards and inwards upon the vessels which enter it at its mesial border. When the colon is mobilised in this way this operation is very much easier and more satisfactory than a right *lumbar* colostomy which does not allow the formation of a proper spur to prevent fæces reaching the transverse colon.

MAKING AN ARTIFICIAL ANUS IN THE TRANSVERSE COLON

This may be performed as a temporary measure when a removable growth of the splenic flexure or descending colon is discovered during an exploratory laparotomy for acute following upon chronic intestinal obstruction. Under these circumstances it is far safer to perform a temporary colostomy than to be too ambitious and to attempt a primary resection. When the intestines have been emptied of their virulent contents, and the patient has recovered from his immediate danger of death, the growth may be resected, an end-to-end anastomosis performed, and the colostomy closed or allowed to close later.

When the cause of the obstruction is found to be a removable growth of the transverse colon, it may be possible to bring the loop of bowel con-

[1] *Ann. of Surg.*, April 1906, p. 543.
[2] *Boston Med. and Surg. Journ.*, September 25, 1902.

taining the growth outside the abdomen and to fix it there by means of a glass rod through the mesocolon or by sutures. The surgeon having protected the abdominal cavity by careful gauze packing, may then be content merely to relieve the obstruction by tying an enterostomy tube in the proximal limb of the loop. Later he can resect the growth and close the artificial anus, or the growth may be immediately removed and Paul's tubes tied in the two limbs of the loop. The contiguous peritoneal coats of the two stumps of intestine may be sutured together to pave the way for the subsequent closure of the artificial anus.[1]

An artificial anus in the transverse colon is, from its high position, more manageable than a sigmoid colostomy, and from the more solid character of the fæces it is better than a right iliac or cæcal fistula.

Mr. Bidwell,[2] in an able article, maintained that "colostomy should never be performed for any growth that is situated above the middle of the sigmoid flexure, and that an artificial anus made in such a case should be only a temporary one left after the removal of the growth." For such cases ileo-sigmoidostomy or some other suitable form of ileo-colostomy is far preferable for a surgeon skilled in abdominal surgery. In skilled hands this operation is only a little more dangerous than colostomy, even when the obstruction is complete, but for those less experienced and without the advantages of skilled assistance, colostomy remains the safest if not the most brilliantly successful treatment.

The disadvantages and constant annoyances of a colostomy are so great and so well known, that a patient may reasonably be advised to run some additional risk in order to avoid them ; thus after an anastomosis a man may be able to lead an active and profitable life for a considerable time without becoming unpleasant to his neighbours, which is a rare thing after colostomy.

APPENDICOSTOMY

This operation was first described and practised by Dr. Weir, of New York.[3] He was performing a cæcostomy for chronic colitis when the appendix presented itself just at the right moment, and Dr. Weir saw and took immediate advantage of his opportunity. Later the important contributions of Mr. Keetley[4] and Sir W. H. Bennett[5] brought the operation into more general notice, and many surgeons have given it a trial. Much of what follows is derived from the excellent and suggestive articles written by the authors named above. The following are the chief conditions and objects for which the operation has been recommended.

Indications. (1) For the introduction of irrigating or medicating fluids into the cæcum and colon in certain cases of chronic colitis and amœbic dysentery.

(2) For the introduction of fluids into the cæcum in a few cases of obstinate chronic constipation.

(3) For the administration of foods and fluids in a few cases of carcinoma of the stomach, &c.

(4) For temporary drainage of the cæcum in some cases of intestinal

[1] Bidwell, *Brit. Med. Journ.*, vol. i, 1902, p. 322.   [2] *Loc. supra cit.*
[3] *New York Med. Record*, August 9, 1902.
[4] *Brit. Med. Journ.*, vol. ii, 1905, p. 863.
[5] *Lancet*, vol. i, 1906, p. 419.

obstruction, also for temporary drainage and fixation in some cases of ileo-cæcal intussusception and volvulus of the cæcum.

(5) For the relief of intestinal distension in cases of peritonitis, &c.

These indications will be considered more fully after the description of the operation.

Operation. (*a*) The appendix is sought through the usual valvular incision employed for its removal, the aponeurotic and muscular fibres of the abdominal wall being separated, and the peritoneum divided sufficiently to admit two fingers. Adhesions and other difficulties may cause delay and may even make the operation a serious one, so that it is
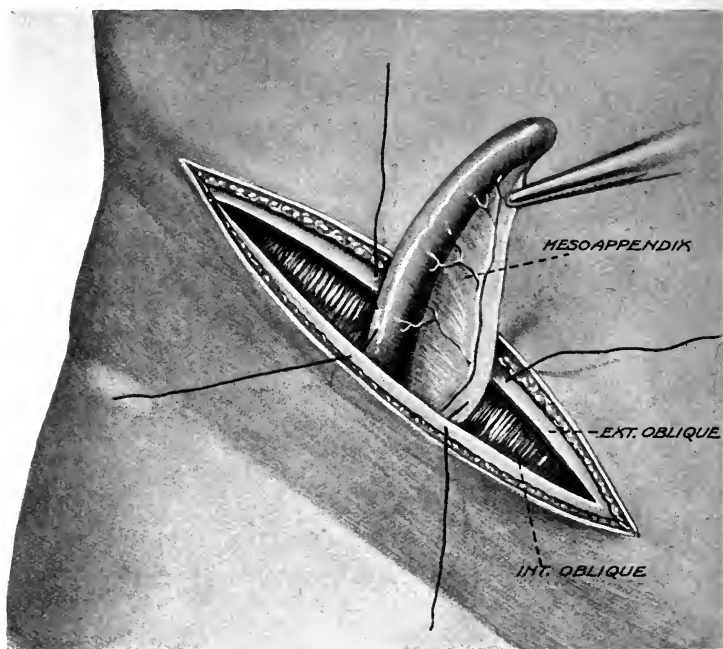
Fig. 150. Appendicostomy. Two catgut sutures fix the mesentery and the sero-muscular coat of the appendix to the external oblique aponeurosis.

not to be lightly undertaken under gas and oxygen or local anæsthesia as recommended by some writers.

The appendix is drawn out through the wound so that the cæcum is brought into contact with the abdominal wall, and two fine catgut sutures are passed through the sero-muscular coats of the cæcum and the parietal peritoneum, and tied so as to fix the cæcum, and close the peritoneal wound without compressing the vessels of the meso-appendix. Two catgut sutures are used to fix the appendix to the aponeurosis, as shown in Fig. 150.

Care must be taken not to damage the vessels or subject them to much tension. Curl [1] mentions three cases in which the appendix sloughed even after careful handling. Sometimes the mesentery is so short that it has to be tied and divided. When there is no need for immediately opening the appendix, Sir William Bennett retains it in

[1] *Ann. of Surg.*, April 1906, p. 545.

position by means of two sterilised safety-pins passed through the sero-muscular coats of the appendix, and closes the abdominal wound beneath the pins. After twenty-four hours, when adhesions have formed, the appendix may be cut across a quarter of an inch from the level of the skin, and the margins of the opening sutured to the edges of the skin ; these sutures serve to prevent undue retraction of the appendix during healing. If the parietal wound be carefully closed the appendix may be opened at once, if necessary, and a soft rubber catheter with a fine flexible stilette can then be inserted for the introduction of fluids.

(b) During an exploratory laparotomy, the surgeon may decide to use the appendix as a temporary spout for the escape of fæces or gas, as recommended by Mr. Keetley.[1] A stab wound can then be carefully made in the abdominal wall over the appendix, which can be drawn out and fixed in the manner described above. If necessary the lumen can be stretched by means of fine-bladed forceps, or by bougies. When the fistula has served its purpose it may be closed most easily by the simple method described by Mr. Maunsell. He dissects away the mucous lining of the stump and leaves a short muscular tube, which heals in a few days ; thus a laparotomy is avoided.

Appendicostomy is usually a very simple operation, but occasionally it cannot be performed, for the appendix may have been already removed, or be so tied down with adhesions, or so diseased and contracted at its base, that it cannot be safely used. Mr. Spencer[2] found the appendix so adherent that he had to perform cæcostomy in one case. In one hundred autopsies at St. George's Hospital, the appendix was a fibrous cord in two bodies, and in two others the lumen near the base would only admit a small bristle ; but an appendicostomy could probably have been performed in the remaining ninety-six.

(1) **Colitis and Dysentery.** As an alternative for cæcostomy and right lumbar colostomy in the treatment of cases of colitis suitable for surgical treatment, appendicostomy has the following important advantages : (i) The fistula does not allow any leakage of fæces, because it is controlled by a sphincter at its base, and is more or less protected by a valve of mucous membrane on its cæcal aspect ; thus the very troublesome irritation of the skin, which is often associated with the older operation, is entirely prevented. (ii) The saving of the fluid contents of the cæcum for more complete absorption in the large intestine may be a gain, especially in very feeble subjects ; thus Goddard maintains that about 10 per cent. of the fat, for instance, is absorbed in the large intestine.[3] (iii) The appendicular fistula is very easily closed, whereas the difficulties of closing an opening in the cæcum are well known.

Gibson's valvular cæcostomy also generally guards against leakage, and it often closes easily on removing the tube ; it is probably the best procedure to adopt when it is found to be impossible to perform an appendicostomy.

Whether the above gains compensate for the lack of rest, and the irritation of the inflamed colon by the fæces, is an open question, only to be decided by time and experience.

The place of appendicostomy and irrigation in the treatment of colitis is as yet uncertain. Mr. Keetley[4] gives the following results of

[1] *Brit. Med. Journ.*, vol. ii, 1905, p. 863.   [2] *Lancet*, March 12, 1904.
[3] *Lancet*, March 25, 1905, p. 795.   [4] *Loc. supra cit.*

nine reported cases. No death had occurred as a result of the operation, but in one fatal case the operation was only performed when the patient was *in extremis*. None of the patients were any worse for the operation. Seven cases were entirely successful, and the issue of the last case remained to be seen.

Nearly all the cases recorded had not been under observation long enough to enable us to arrive at any conclusion as to the ultimate results. Cases have been claimed as cures after a few weeks or months. It must be remembered that these patients must remain well for several years before the results can be claimed to be entirely successful. Every physician knows that relapses are frequent in colitis. Hale White and Golding-Bird [1] publish a case of a relapse of mucous colitis after two years' relief from right lumbar colostomy. Appendicostomy will be found to be of very little use in severe cases of ulcerative colitis and severe cases of dysentery with deep ulceration, for then the fæces must be completely diverted by colostomy. It is of real value in milder cases of colitis, which have not reacted to medical treatment by the mouth and rectum, but care must be taken to keep the fistula open until all signs of the disease have disappeared.

Curl concludes " from observation of eleven cases of dysentery, that in intermediate cases in which there is still a reasonable amount of strength, but where treatment is not controlling the dysentery, the operation of cæcostomy with irrigation of the colon with quinine solution is indicated. Cæcostomy is preferred to appendicostomy because of less sloughing and an earlier closure of the fistula. A rapid improvement usually follows the beginning of the irrigation, but convalescence is slow, and at times difficulty is experienced in closing the fistulæ. The after-treatment—irrigation, &c.—is tedious, and the patients are offensive cases to have in a ward. All in all it is the lesser of two evils, but in my opinion it saves lives in selected cases." [2]

Curl does not state in how many of these cases he performed appendicostomy—presumably a minority only ; it is surprising to read that the fistula closed more rapidly in the cæcostomy cases. Quinine solution was the irrigating fluid used ; in eight out of eleven cases partial or complete recovery occurred ; in two, as demonstrated by autopsy, there was extensive and deep ulceration, and also nephritis. One was so weak that cæcostomy was performed under cocaine anæsthesia, and death occurred the following day.

Many kinds of irrigating fluids have been recommended, such as : normal saline solution, starch, infusion of marshmallow, oil, lime water. Various astringents, such as nitrate of silver solution, ipecacuanha in suspension, glyco-thymolin, argyrol, liquid paraffin, two ounces daily (Ewart) ; quinine solution for dysenteric cases (Curl).

Dr. Dawburn [3] used potassium permanganate 1 in 10,000 solution, alternating every six hours with the same amount of normal saline ; about ten pints of the solutions, at a temperature of 120° Fahr., being used at a time. The case was one of dysentery, and was much improved by the treatment, but the cure was not complete when Dr. Dawburn presented the case only a few weeks after the operation.

Dr. Ewart [4] has given a helpful account of his method of irrigation. A No. 8 india-rubber catheter is introduced by means of a blunt-ended, very pliable copper stilette ; it is apt to coil in the cæcum unless care be taken to pass it upwards as well as backwards. A good-sized rectal tube is then passed to conduct the outflow into a suitable receptacle by the side of the bed. Tubing and funnel are fixed to

[1] *Clin. Soc. Trans.*, 1902.   [2] *Ann. of Surg.*, 1906, vol. xliii, p. 543.
[3] *Ann. of Surg.*, vol. xxxvii, p. 613.   [4] *Lancet*, vol. i, p. 1511, 1906.

the catheter, and both the afferent and efferent tubes have clips attached, and also a piece of glass tubing inserted. By elevation and depression of the funnel the rate of the injection can be regulated, and the rate of the outflow and amount of distension of the colon (if any is desirable) can be controlled by means of the clips. Dr. Ewart has used as much as twenty pints in one irrigation.

It is probable that the hopeful results obtained depend more upon the careful lavage than upon any particular kind of chemical solution used. The patient should not complain of pain during the irrigation unless the outflow be obstructed, or too much pressure be employed. The patient should be kept supine unless the fluid does not run well, when he may be turned on to his left side to overcome any possible obstruction at the hepatic flexure of the colon.

(2) **Chronic Constipation.** Mr. Murray[1] first suggested appendicostomy as a treatment of intractable cases of chronic constipation. Since then Mr. Keetley[2] and others have tried the operation.

A girl of 15 suffered from severe chronic constipation. At the time of the operation the bowels had not been opened for three weeks, and the patient was vomiting. Median laparotomy disclosed a pendulous transverse colon reaching to the pubis, but there was no other abnormality. The appendix was brought out through a button-hole incision, and the median incision closed; the appendix then slipped back and had to be brought out again and fixed. Four days later the superfluous part of the appendix and its mesentery were removed without causing any pain. The ligature which secured the vessels of the meso-appendix was also used to retain a soft tube inserted in the fistula. A saline injection was given, and later some ʒij of mist. alba, and a pint of saline. These were very efficacious, and lately an injection of water alone procures a daily evacuation. The patient herself passes a No. 10 catheter. No leakage occurs, and the patient's health has much improved.

It remains to be seen whether this treatment may be proved by more experience to be of real and permanent use in the treatment of those rare cases of constipation which are not amenable to medical treatment. It is certainly worthy of trial in preference to such drastic measures as colectomy, but in some it has proved disappointing.

(3) **Ileo-Cæcal Intussusception.** Mr. Keetley[3] performed appendicostomy after reducing an intussusception of the lower end of the ileum, cæcum, and appendix in an infant aged one year and ten months. The reduction was performed through an incision in the right rectus, and then the appendix, six and a half inches long, was pulled out through a button-hole incision made over it, and the end was cut off and the stump fixed. ʒviij of normal saline were injected at 6 P.M., and the bowels were moved at 7 P.M. and 9.45 P.M. The stump of the appendix was removed fifteen days later, but its site was fixed to the wound.

The operation was performed for several reasons: for the relief of gaseous distension, the administration of fluids which acted partly as aperients, and fixation of the bowel with a view of preventing recurrence.

The appendix would probably be of even more service in cases of primary cæcal intussusception.

(4) **Volvulus of the Cæcum.** The following interesting case recorded by Mr. Maunsell is probably the first in which appendicostomy has been tried for volvulus, and it is certainly encouraging.

Female, æt. 77, subject to chronic constipation. Volvulus of the cæcum was discovered in the pelvis on exploration; the greatly distended cæcum was deflated

[1] *Brit. Med. Journ.*, vol. i, 1905, p. 1299.
[2] *Ibid.* vol. ii, 1905, p. 863.
[3] *Loc. supra cit.*

and then withdrawn and uncoiled, and the puncture closed. The appendix was brought out through a stab wound at the outer border of the right rectus. Some vessels of the meso-appendix had to be tied ; the appendix was fixed by two sutures and its distal end amputated. The fistula was dilated with sinus forceps and a gum-elastic catheter tied and left in for four days. From the first gas and some fluid fæces escaped from the opening and the abdomen kept flat. Later the mucous membrane lining of the stump was excised and the fistula closed in a few days. The patient did very well although some suppuration occurred in the exploratory wound, probably due to soiling during deflatation.

(5) **Intestinal Obstruction.** In 1894, Keetley [1] first suggested the use of the appendix as a spout for the relief of intestinal obstruction, instead of cæcal colostomy. He was able to put it to a successful test in 1905.[2] The operation has a very limited application, for the drainage it provides is not sufficient in cases of complete intestinal obstruction, and ulceration may develop in the ileum and lead to perforative peritonitis.

In cases of severe intestinal distension embarrassing the breathing and leading to paralytic distension of the intestine if unrelieved, appendicostomy may prove to be a simple way of giving great relief ; especially is this likely to be so in some cases of general suppurative peritonitis, and some cases of intestinal obstruction after removal of the cause.

[1] *Brit. Med. Journ.*, November 17, 1894, p. 1155.
[2] *Lancet*, vol. i, 1906, p. 1023.

CHAPTER XIX

ENTERECTOMY AND COLECTOMY

The term enterectomy is generally limited to resection of a part of the small intestine, and colectomy means resection of a part or the whole of the colon.

Indications. Resection is usually a severe and sometimes a grave operation, which should not be undertaken when a simpler and safer method is sufficient, *e.g.* the simple suture and inversion of a perforation or wound of the intestine. Lateral anastomosis for innocent stricture is often as efficient and far safer than resection although it is not so spectacular. The most common indications for enterectomy are injuries and gangrene of the bowel. The most common indication for colectomy is malignant disease of the colon.

(i) **Severe injuries of the bowel or mesentery** (*see* Chapter XVII).

(ii) **Gangrene of the bowel in a strangulated hernia or due to intestinal obstruction, intussusception, volvulus, embolism, or thrombosis of the mesenteric vessels,** but resection is not always the best treatment. **The treatment of gangrenous strangulated hernia** may be taken as an example.

Relief of a strangulated hernia is one of those operations of emergency, sometimes admitting of no delay, which any general practitioner must undertake, often under very unfavourable circumstances. It would be most unfair to expect that such a man, when face to face with a gangrenous hernia, should meet it in the same way as a hospital surgeon, able to command the very best surroundings, abundant help, and himself experienced in intestinal surgery. As I have said in Chapter III, when the condition of the patient, the experience of the operator, and his surroundings admit of his taking this step, resection of the gangrenous intestine should always be performed. Where the above conditions are absent, the operator must rest content with enlarging the wound,[1] drawing all the gangrenous intestine well outside the peritoneal sac, opening and draining it thoroughly by one of the means given in Chapter XVIII. This will avoid the terrible risks of paralysis of the bowel, stercoraceous vomiting, exhaustion, or toxæmia. The loop must be kept outside by a sterilised bougie or glass rod, as in inguinal colostomy (p. 255), aided by a few sutures. Any gangrenous omentum must be removed, and the sac cleansed as far as possible.

Gibson gives the mortality of primary resection and end to end union as 26 per cent., and that of artificial anus formation as 53 per cent., but these figures must not be accepted too literally, for the most severe cases are often considered to be unsuitable for resection, and artificial anus is made as a last resort in such cases.

[1] In a very few cases, where the surroundings are even more unfavourable, the operator may have to be content with simply opening the bowel and doing no more.

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Sometimes the gangrene is so limited that resection is not the safest treatment. Five cases of partial gangrene of the intestine treated by inversion of the gangrenous or ruptured portion are very briefly given in an instructive but very short paper by Mr. Caird : [1]

All five were cases of hernia. There was a " perforation " of the intestine in one, and a " rupture " in two. Of the five cases three recovered. Of the two which died, one was an infant aged 18 months. The necropsy showed firm union of the intestine without peritonitis. " The intestine was beset with typhoid ulcers of ten or fourteen days' duration."

The following is Mr. Caird's advice as to the treatment of gangrenous intestine by inversion, and the cases suitable to this method : " If we meet with the typical elliptical necrosis of the bowel which runs longi-tudinally opposite the mesenteric attachment, we may, with Lembert's sutures, stitch the sound tissues over the unhealthy, thus inverting the gangrenous area into the lumen. This practice, which obviates the necessity of cutting any part of the bowel away, and requires no special dexterity, is in all probability not applicable with safety where more than one-third of the circumference is destroyed. The fear of stricture ensuing rather determines us to resect in such cases. . . . The method of inversion, although easy, cannot be modified to meet the exigencies of every case. It does not lend itself to those instances in which the gut is almost completely divided by the tight grasp of a narrow femoral ring. The vitality of the proximal end has then been too severely tried to admit of such an experiment. We should require to invaginate a few inches of the damaged gut before we came upon healthy tissue to suture ; and since it is impracticable to reproduce the successful natural cure occasionally seen in cases of intussusception, we are driven to resect." If inversion be made use of, the greatest care must be taken, as in partial or complete resection, to ensure that the sutures lie in healthy tissues.

Mr. Makins [2] also draws attention to the value of inversion in some cases ; he records two successful operations, in one of which an area three-quarters of an inch in diameter was inverted.

(iii) **Malignant disease, usually carcinoma,** of the bowel or invading it. This is common only in the colon, but it may occur in any part of the small intestine. Tatlow [3] has recorded three interesting cases under the care of Sir Berkeley Moynihan. In one of these the growth was at the duodeno-jejunal flexure. In two cases the growth was successfully resected. The third was too late for radical treatment and was treated by lateral anastomosis.

(iv) **Tuberculous disease of the small or large intestine,** causing one or more strictures, usually in the ileum, or tumour-like masses from infiltration of the walls of the bowel. This is common in the cæcum and has often been mistaken for malignant disease. Usually the mes-enteric glands are also affected. In many cases ileo-colostomy with exclusion is the only justifiable operation, and it is generally satisfactory in relieving the chronic obstruction and in causing resolution or fibrosis.

(v) **Chronic inflammatory affections,** such as colitis with pericolitis and chronic obstruction commonly, but not always, due to inflammation spreading from diverticula of the colon.[4]

[1] *Edin. Med. Journ.*, 1895, p. 312.
[2] *Clin. Soc. Trans.*, vol. xxxvi, p. 183.
[3] *Lancet*, 1912, vol. i, p. 991.
[4] Telling. *Lancet*, 1908, vol. i, pp. 843 and 928. Rowlands, *Lance.*, 1910, vol. i, p. 1194.

(vi) **Fæcal fistulæ,** which cannot be closed satisfactorily in any other way.

ENTERECTOMY

The technic of the operation naturally varies with the nature and extent of the disease. Thus the mesentery containing infected lymphatic glands must be freely excised in the rare cases of malignant disease of the small intestine, whereas only a little of it needs removal with gangrenous bowel.

There are several methods of joining the bowel after the diseased part has been removed :

(i) *End-to-end union.*

(ii) *End-to-side union after closing the lower end.*

(iii) *Side-to-side union after closing both ends.*

(i) **Resection with End-to-End Union.** (*a*) As a typical example the *resection of gangrenous small intestine found in a strangulated hernia* will be described in detail. Usually a considerable length of bowel has to be removed.

The first question that arises when resection is determined upon is whether we should carry it out through the original wound enlarged, or through a second in the abdominal wall. Where union by suturing is adopted, especially in umbilical or inguinal hernia, it will be sufficient to enlarge the wound if necessary either to allow an extensive resection to be carried out, or to facilitate the reduction of the sutured intestine and the bulky mesentery.

In femoral hernia it is wise to make a fresh incision through the lower part of the corresponding rectus sheath, unless the amount of bowel to be removed is very small. This is better than to have to divide Poupart's ligament, in order to get a proper view of the damaged bowel above the obstruction. This ligament will have to be divided if the resection is completed below the femoral canal, otherwise it will not be possible to reduce the sutured bowel and the mass of mesentery without exerting undue force. Barker [1] was compelled to sever Poupart's ligament on this account after the resection of eighteen inches of small intestine ; a large hernia developed at the site of the operation and had to be treated by another operation two and a half years later.[2]

A hernia is not likely to form at the abdominal wound which should be valvular, and should be sutured with due care. The adoption of this second incision will, of course, involve a risk of carrying infection into the peritoneal sac and the abdominal wound, and every precaution must be taken to lessen this danger, which has been exaggerated.

Any gangrenous or septic omentum having been tied off and removed, the sac and damaged intestine are carefully cleansed, any opening in the bowel being temporarily but firmly closed. If this is not possible the mesentery should be tied, and the gangrenous loop excised, the divided ends being cleansed, tied, invaginated, and drawn upwards and out through the abdominal wound.

The second question concerns the length of bowel to be resected. Care should be taken to remove too much rather than too little, for we find in many of the fatal cases reported that the cause of death was attributed to gangrene spreading upwards above the seat of suture ; on the

other hand, we find that recovery has followed when large portions of the intestine have been removed.

Barker [1] has successfully resected over six feet of small intestine for gangrene of a loop due to femoral hernia in a woman of sixty-three years. Peck [2] removed eight and a half feet of gangrenous small intestine without any subsequent loss of nutrition during the succeeding two years; at the end of this time an operation was performed for the relief of a ventral hernia, and the bowel was examined and found to be normal in appearance, no sign of the line of union being seen. Kocher quotes Monari to the effect that up to seven-eighths of the intestine of animals may be removed without harm, and Roux has recorded the case of a patient who survived with only five feet of small intestine and half the length of his large intestine.[3] Whitall [4] has successfully resected ten feet eight inches of the ileum, and the patient, a woman, recovered without any sign of malnutrition. He draws attention to the fact that more of the lower part of the small intestine than of the jejunum can be removed without detriment.

In any variety of strangulated hernia, the intestine above the obstruction must be examined, and the site for the upper line of section should be chosen with great care. The lower section may be within two inches of the lower constriction.

No paralysed, congested, or greatly distended bowel should be left behind ; failure to remove enough may lead to death from toxæmia, paralytic distension, enteritis, or peritonitis, the latter being due either to sloughing of the upper end at the line of suture, or to infection of the peritoneum through the wall of the damaged intestine, without any visible perforation. Mr. Barker [5] has strongly advocated more extensive resections in all cases which need resection at all. Sound tissues may thus be obtained for suture, paralysed intestine in a condition of infective cellulitis may be removed, together with pints of poisonous contents, which would otherwise become absorbed to some extent with lethal effects.

Clairemont and Ranzi [6] have shown how poisonous these retained products are, and others have proved how virulent the bacillus coli becomes in cases of intestinal obstruction.

It is important to examine the mesentery to find out the condition of its blood-vessels, the presence of pulsation and the absence of œdema or extravasation of blood being essential at the line of section.

Barker points out that an extensive resection takes very little more time than a small one, and that there is hardly any difference in the amount of shock induced.

Operation. The intestine to be removed is drawn well out of the wound, and its base surrounded with two layers of moist gauze packs to protect the wound and peritoneum. The two ends of the loop are placed together and clamped with a single pair of Doyen's long clamp forceps, as advised by Mr. Barker [7] and shown in the figures. Traction is then made upon the middle of the loop to get the mesentery taut and free of folds, and the two layers are clamped together with another pair of long clamps, whose points should reach that of the first pair if possible

[1] *Lancet*, 1903, vol. i, p. 1579.   [2] *Ann. of Surg.*, 1903, vol. xxxviii, p. 451.
[3] Kocher, *Oper. Surg.*, p. 260.   [4] *Ann. of Surg.*, 1911, vol. ii, p. 559.
[5] *Lancet*, 1903, vol. i, p. 1579.   [6] *Ann. of Surg.*, 1903, vol. xxxviii, p. 914.
[7] *Loc. supra cit.*

(*see* Fig. 151). If the resection is very extensive, a third pair of clamps may be applied to the remainder of the wide mesentery, by thrusting one of its blades through both layers near the tip of the second pair. The

Forceps clamping
both ends of
the loop

Line of section
of mesentery

Forceps clamping
the mesentery
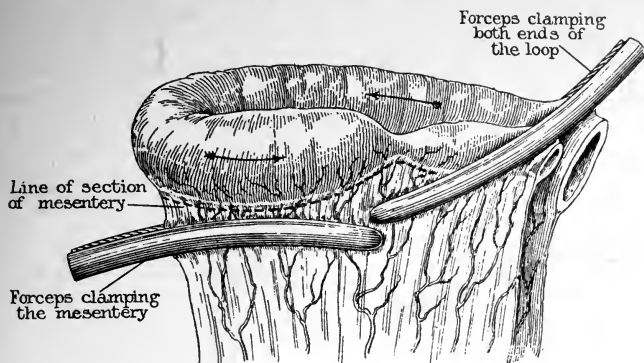
FIG. 151. Resection of gangrenous intestine. The folded loop here shown is short for convenience of illustration. (After Barker, *Lancet*.)

mesentery is divided between the clamps and the intestine, and the proximal end of the loop is liberated from the first clamp, which should still hold the distal end and both mesenteries. A fresh clamp is placed near

Forceps clamping
the distal end
of the loop

Ligatures piercing both
layers of mesentery

Forceps clamping
folded mesentery

Open end of the loop of
intestine moved well
away from the wound
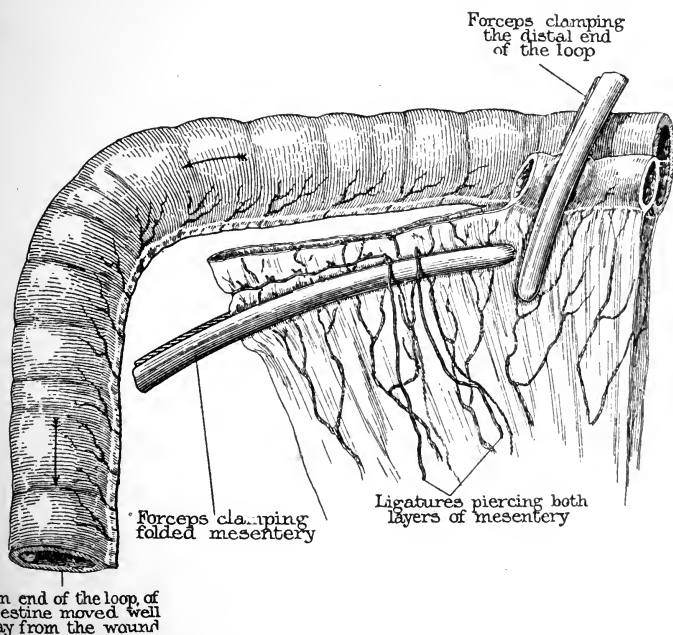
FIG. 152. Resection of gangrenous intestine. The folded mesentery is tied, while the contents of the distended intestine drain away. (After Barker.)

the distal end of the loop, which is then divided between the two clamps, brought away from the wound and liberated over a basin at the side of the table. While the contents of the intestine are being drained away as far as possible, the two layers of the mesentery are sewn together with

mattress sutures of silk, each suture securing about two-thirds of an inch of the two membranes (*see* Fig. 152). The intestinal ends, if unequal in calibre, are placed and clamped together obliquely, so that more may be removed from the convex border of the smaller one, in order to equalise the sections to facilitate the suturing. The projecting pieces are then shaved off close to the clamp forceps, and another clamp is applied to both tubes parallel with the first, but nearer the body, or a separate clamp is applied to each tube. The first is then removed, leaving one-third of an inch of each extremity projecting beyond the second clamp. The mucous membrane is cleansed with moist swabs (*see* Fig. 153).

Forceps clamping both ends

First or deep suture being introduced

Tail thread of deep suture
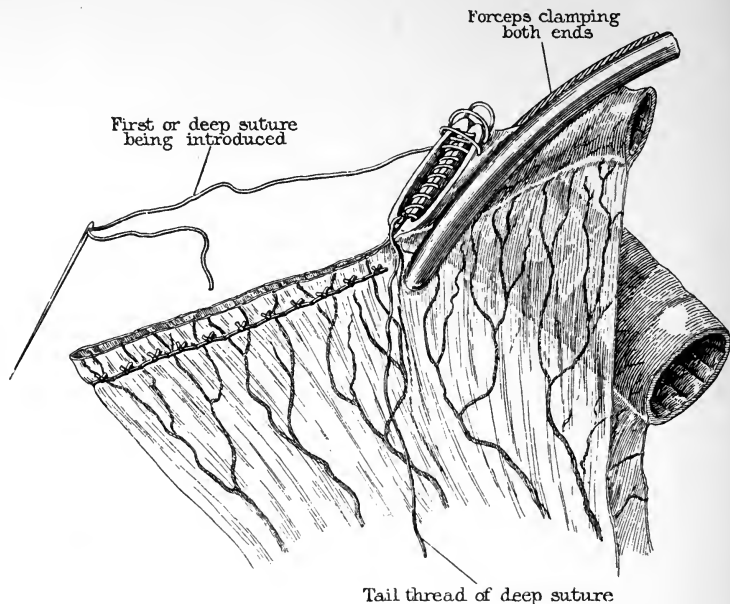
Fig. 153. Resection of gangrenous intestine. The loop has been removed, and the healthy ends are being joined. The distal smaller end is clamped and divided obliquely so as to make the section equal to the dilated proximal end. (After Barker.)

End-to-End or Axial Union. In joining the ends together the mesenteric space must be obliterated in order to secure peritoneal apposition and prevent leakage at this dangerous point (*see* Figs. 154 and 155). The clamp forceps are held, locked, or tied together. A mattress suture of fine linen thread is inserted at the mesenteric border (as shown in Fig. 156), and tied within the bowel. This completely obliterates the mesenteric triangle and also inverts the edges of the bowel. To maintain inversion of the edges, keep them taut and raise them up, tissue forceps are applied at the free border (Fig. 157). One end of the long suture is used as a continuous Connell suture to unite the edges which lie in contact and are inverted. The thread secures a good, but not excessive, bite and pierces the bowel at intervals of one-eighth of an inch. When the free border is passed the other end of the suture is used to close the remainder of the wound; it is passed after Connell's method from the serous surface, leaving loops on the mucosa. In this way the finishing-point is well away from

the dangerous mesenteric border, and more easy to see and invert properly. Both ends of the suture terminate and are tied together on the mucous
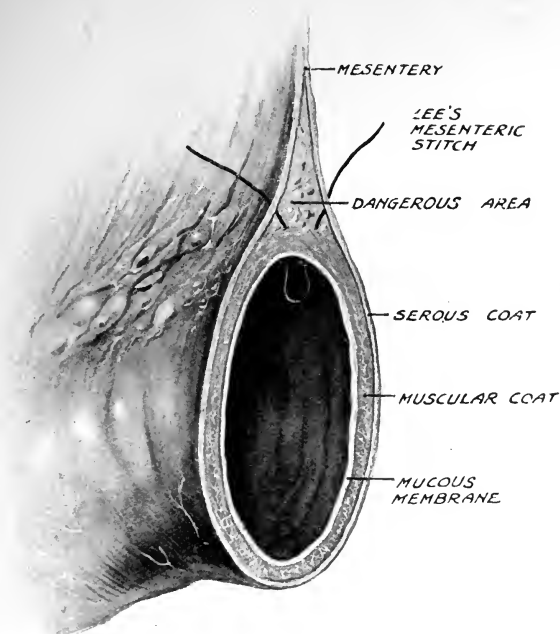
FIG. 154. Section of small intestine and mesentery, showing the various layers and the mesenteric space or dangerous area.

surface. This lessens the risk of leakage at the knot (*see* Fig. 158). It will be noticed also that very little, if any, of the Connell suture is visible
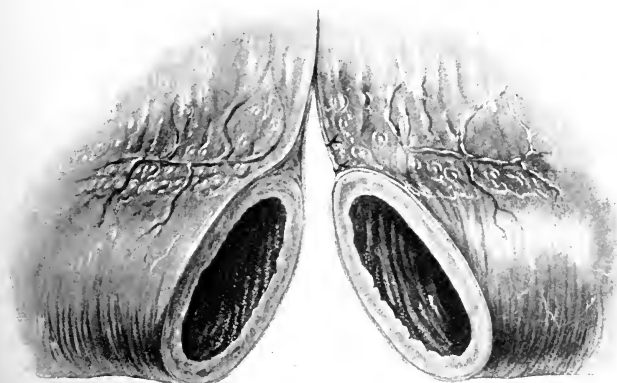
FIG. 155. The sections run obliquely across the intestine to secure an adequate channel after suture and a reliable supply of blood to the free edge. Two sutures are shown obliterating the dangerous space on the right side. Clamps are always used.

upon the serous surface, for it buries itself, thus minimising the danger of peritonitis and troublesome adhesions. For these reasons it is not

necessary to reinforce or bury the suture with sero-muscular sutures ; thus time is saved and the risk of the formation of a diaphragm is smaller.
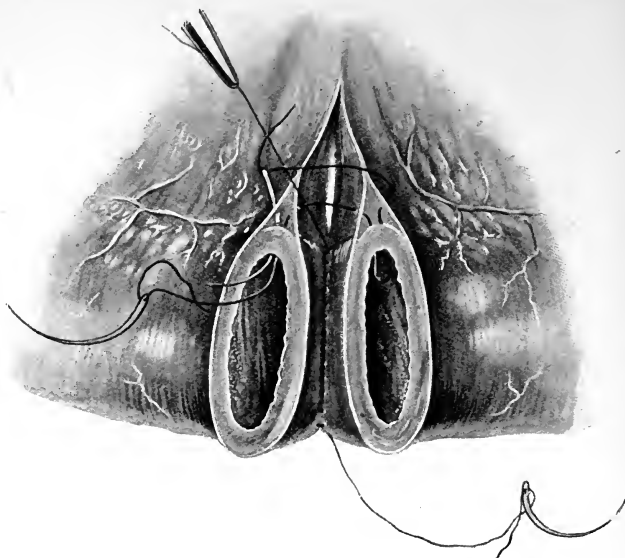
FIG. 156. Lee's mesenteric stitch to obliterate the dangerous space. The first half of the continuous serous suture is also shown. The clamps are not shown.
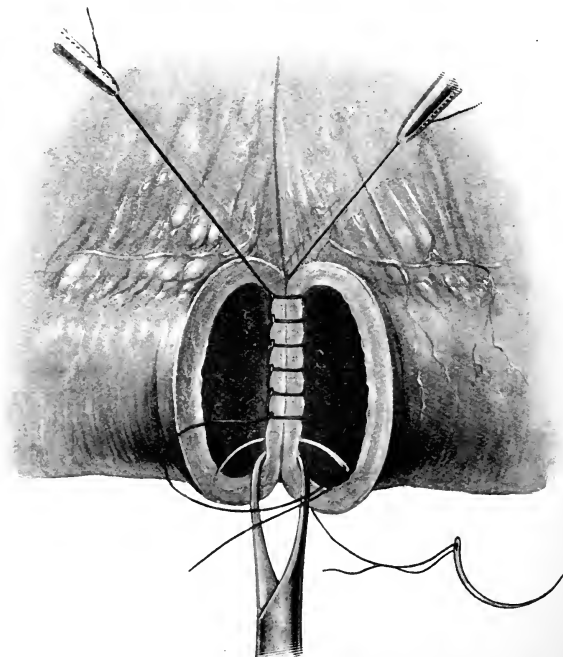
FIG. 157. The button-hole stitch : this does not run and narrow the channel.

A continuous suture is far speedier and more accurate than interrupted sutures. Moreover it prevents dilatation of the intestines and

the circle of union, and thus acts as a splint which protects the union from the stretching effects of intestinal distension, whereas interrupted
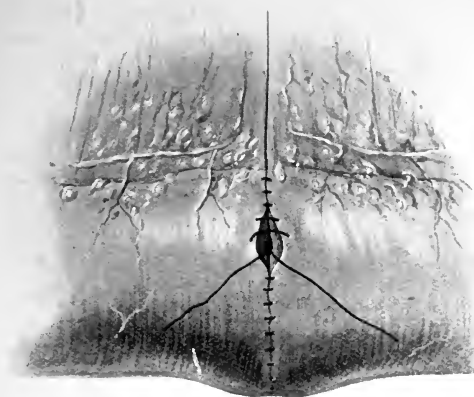
Fig. 158. The deep suture nearly completed. The knot is placed on the mucosa.

sutures do not prevent stretching between the individual stitches (*see* Fig. 159).

It has been shown by Dr. Horsley and others that the Connell suture
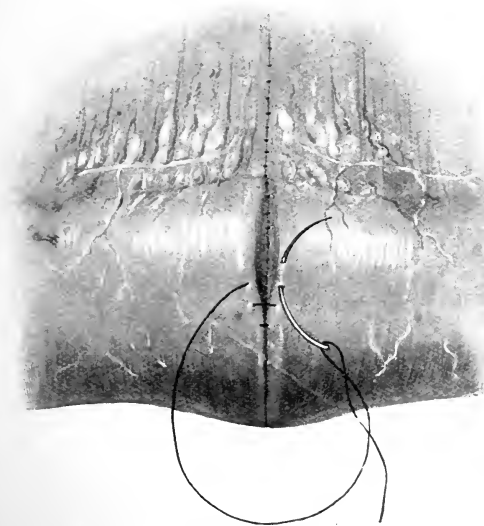
Fig. 159. The serous suture after Cushing's method. The mesenteric gap has been closed.

holds very securely, especially during the critical time for intestinal sutures, which sometimes slough out and allow leakage on the third, fourth, or fifth day. The union is far more certain and secure than that obtained with mechanical contrivances, such as the Murphy Button.

Clinically leakage rarely occurs with Connell's method. Connell[1] gives a table of sixty-four operations performed by different surgeons by his method. Of the twenty-one deaths, only one was due to leakage, all the others were due to shock, previous peritonitis, &c. In animals, Ferguson found that of 300 anastomoses performed in this way on animals by post graduate students, the mortality was only 3 per cent.[2] But few English surgeons care to dispense with a sero-muscular re-inforcing suture; and the danger of the formation of a diaphragm is small in the adult human subject, although it is considerable in experimental work upon intestines of small calibre. To prevent narrowing at the circle of union, Horsley excises a semilunar piece from each of
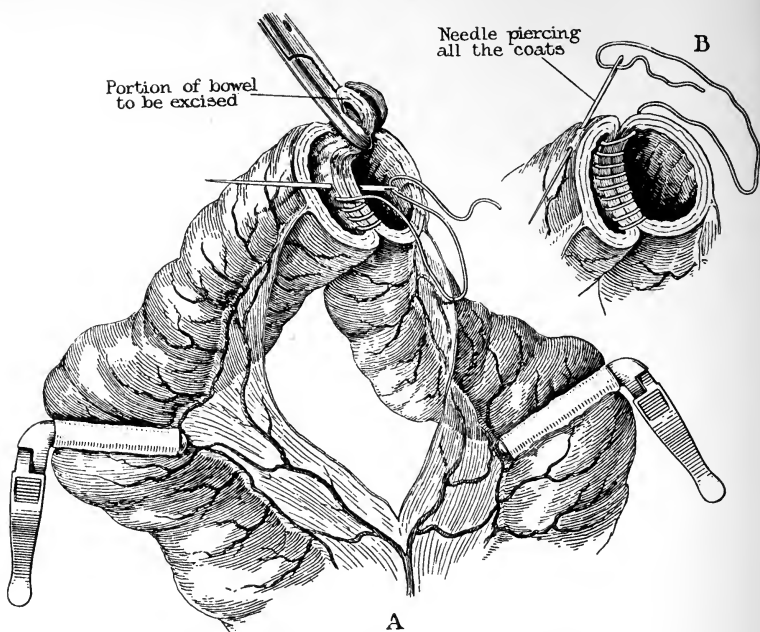
FIG. 160. (After Horsley, *Ann. of Surg.*)

the intestinal ends. This is rarely necessary in the comparatively large intestines of man (*see* Fig. 160). An oblique section is generally sufficient. To strengthen the line of union a graft of omentum or a flap of the peritoneal covering of the mesentery may be tacked over it.

The intestine and mesentery are cleansed with moist swabs and replaced within the abdomen after the packs have been removed. *Firm union is most likely to occur when the joined intestine is completely surrounded by peritoneal surfaces which soon adhere to and protect the line of suture.* When this desirable protection is not available failure of union and the formation of fistula are not uncommon. For this reason it is rarely wise either to leave sutured intestine exposed in the wound, or to insert a drain down to the suture line.

[1] *Amer. Med.*, vol. v, p. 135.
[2] *Ann. of Surg.* 1901 vol. xxxiv, p. 346.

Advantages and disadvantages of Circular Enterorraphy.

Advantages. End to end union by simple suture seems to be ideal in its apparent simplicity, almost perfect restoration of the natural shape and condition of the bowel, the entire absence of any special or complicated apparatus which may not be always available. No troublesome foreign body is left behind which may give trouble before it comes away.

Disadvantages. It must be remembered, however, that although the channel may be completely restored the nerve supply may be interrupted, and that this may interfere with the natural wave of peristalsis, and lead to dilatation of the intestine above the anastomosis, especially when there is any narrowing at the anastomosis as so often happens with end-to-end union.

Those who condemn it as unsuccessful must remember (1) that it has been gradually and slowly perfected, being often laid aside for some new device, and then resorted to again, and that it was very largely used in the earlier and darker days of intestinal surgery ; (2) that when used by skilled hands it has proved most effective and reliable in the time of emergency. When used by such hands—and it is one advantage of this method that it is easy for any operating surgeon to acquire skill in it—care will be taken to fulfil the conditions necessary for successful enterorraphy, viz. (*a*) sufficient inversion of the serous coats ; (*b*) penetration of all the coats by one of the rows of stitches, which should have all knots on the mucous surface ; (*c*) careful adjustment of the junction of the intestine and the mesentery (Figs. 154 to 159) ; and (*d*) placing of the sutures in healthy tissues.

It is right to state clearly here that many excellent judges, men well experienced in intestinal surgery, condemn circular enterorraphy. Thus Dr. A. B. Robinson [1] states that he found it, from experiments on dogs, very dangerous, for the following reasons : (1) It paralyses the gut, and hence does not so readily relieve the fæcal obstruction which is the immediate object of surgical interference. To this it may be replied that the joining of ends of intestine resected while obstruction is present should be deferred whenever possible ; and when this is not possible—a rare contingency—the intestines should be thoroughly emptied before they are united. If this is not practicable, union should be deferred and drainage continued by Paul's tubes (Figs. 146 and 147. (2) A fæcal fistula is apt to arise at the point of suture. (3) Gangrene or sloughing may arise from the pressure of numerous sutures. These are very fair criticisms. They must each be met by care in suturing, and by attention to the junction of the intestine and the mesentery. (4) The lumen of the two ends may be unequal. When this difficulty is marked, circular enterorraphy must be abandoned for intestinal anastomosis. (5) Pathological changes due to obstruction in the bowel may offer impediments. The gut may be stretched so thin that a needle cannot be passed between the muscular and mucous layers without danger of penetrating the mucous layer and causing fæcal fistula, but with Connell's suture this does not matter so much. I have pointed out elsewhere (p. 294) that union of resected intestine is not to be attempted where obstruction, over-distension, &c., are present.

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[1] *Ann. of Surg.*, vol. i, 1891, p. 430.

Where the distension has been prolonged, as in malignant disease low down in the canal, circular enterorraphy is contra-indicated. This is not the case where the obstruction has been of shorter duration—*e.g.* in gangrenous herniæ—as shown by the successful cases given at p. 271. (6) Circular stricture followed the experiments. Some of the strictures were so severe that both fæces and gases were actually obstructed. This is a very rare sequel in the human subject, as shown lately by W. A. Evans.

It is clear, I think, that, in the hands of an operating surgeon who has taken care to acquire skill by practice, the chief **objections** to enterorraphy have been very greatly reduced—viz. the time taken, the number of sutures needed, the risk of yielding of sutures, of leakage at the junction of mesentery and intestine, and of stenosis from contraction of the cicatrix, especially if the inversion has been needlessly free.

Where the surgeon, from any want of faith in his skill, or from the condition of the patient requiring that the operation should be completed speedily, prefers to rely upon one of the devices intended to aid or to replace circular enterorraphy, he will be wisest in making use of Murphy's button, on account of the rapidity with which the operation can be completed. For although there are undoubted objections to the use of the button, careful adjustment in well-nourished intestine, and a wise selection in choosing the size of button to be used, will avoid most of them. Moreover, it must be remembered that the accidents that have happened are comparatively rare, and the results, as far as can be judged, are on the whole satisfactory. Comparison between Murphy's button and other methods of resection in the series of 226 cases of resection of intestine for gangrenous hernia collected by Gibson[1] is on the whole to the advantage of the Murphy button, for in the sixty-three cases in which Murphy's button was used there were fourteen deaths, *i.e.* a mortality of 22 per cent., while in the remaining 163 cases in which various other methods were made use of there were forty-four deaths, or a mortality of 27 per cent.

Ferguson[2] states that in 115 anastomoses by means of the button, and performed by graduated students, on dogs the mortality was only 2 per cent., whereas in 300 operations by Connell's method the mortality was 3 per cent. In fifty operations by the Czerny-Lembert method the mortality reached 22 per cent., and in fifty operations after Maunsell's manner 25 per cent. of the dogs died.

Other Methods of End-to-End Union. To avoid some of the dangers and difficulties of circular enterorraphy, various modifications and mechanical aids have been introduced, but few of these have stood the test of time, and most of them have become obsolete as a result of improvements in the technique of the various methods of anastomosis by simple suture. Maunsell's method of suture is still occasionally used but it has been largely replaced by Connell's method, which is simpler and does not require an additional wound in the bowel.

The Murphy button is sometimes used when there are grave reasons for hurry, or when joining parts which are not easily made accessible for safe simple suture. Some surgeons use the button to join the ileum to the colon, for here the fear of impaction of the button is remote ; but the other dangers associated with its mode of separation remain, and

[1] *Ann. of Surg.*, November 1900.   [2] *Ann. of Surg.*, 1901 vol. xxxiv.

are, to my mind, sufficient reasons against its use by a surgeon who can sew well and rapidly.

Method of Maunsell.[1] This modification of circular enterorraphy is based on the fact that, when Nature performs enterorraphy successfully, she does so by the process of invagination, adhesive inflammation, and sloughing. The two ends of the bowel are brought together by two long temporary sutures passed through all the coats of the intestine (D D, Fig. 161), one being placed at the mesenteric junction, and the other exactly opposite. These sutures secure the peritoneal covering of the intestine, and serve later to effect invagination. A slit about an inch and a half long having been made in the long axis of the free border of the proximal part of the intestine, about an inch from the divided end of the gut, these two long sutures are passed up through the lumen of the bowel and out of the slit; when pulled upon, the
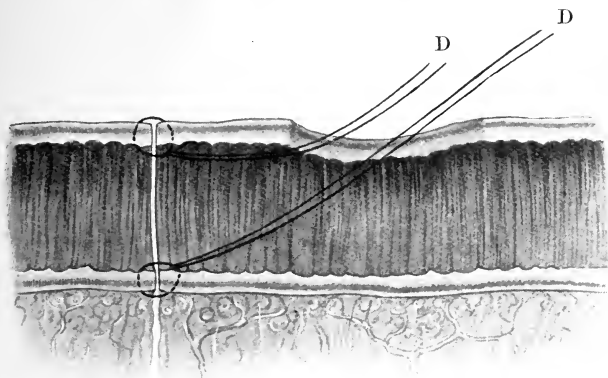
FIG. 161. Maunsell's method. The sutures D D serve to invaginate the ends and bring them out through a lateral incision for suture.

smaller or distal end of the bowel will be invaginated into the larger, and drawn out of the opening in this (Fig. 162). From this figure, which shows the relative position of the layers invaginated, it will be seen that the peritoneal surfaces are in accurate apposition all round. While an assistant holds the ends of the temporary sutures up and apart, the surgeon passes a long, fine, straight needle, carrying fine linen thread, through both sides of the bowel, taking a good grip (a quarter of an inch) of all the coats). The suture is then hooked up from the centre of the invaginated gut, divided, and tied on both sides. *In this way twenty sutures can be rapidly placed in position with ten passages of the needle.*[2] The temporary

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[1] H. Widenham Maunsell, late Lecturer on Surgery, Otago University (*Amer. Journ. Med. Sci.*, March 1892). The inventor used his method first as long ago as 1886, after resection of the small intestine " for cancer " in a child aged 6. The child sank on the sixth day; at the necropsy the segment of the intestine showed no evidence of leakage. Dr. Wiggins (*New York Med. Journ.*, December 1, 1894, and in his pamphlet, for which I am indebted to him) relates a successful case in which he resected six inches of ileum for contusion and perforation, uniting them by this method. The patient was well ten months later. Dr. Wiggins mentions a case of Dr. Harley's (*New York Med. Journ.*, vol. lvi, pp. 302 and 464) in which this method was also successfully employed for the resection of a double intussusception and carcinoma.

[2] Mr. Stanley Boyd introduced here two or three modifications of this important stage, which may be useful. Finding that time was lost in drawing up the loops from the lumen of the bowel, and in selecting corresponding ends, he passed many of these sutures not

sutures are now cut off short, and the invaginated gut is then pulled back.[1]   A continuous button-hole suture is far better (Fig. 162).   Finally, the longitudinal slit in the gut is well turned in, and closed by two continuous sutures of fine linen thread, one piercing all the coats and the other only a Cushing suture.   The serous surfaces should be in accurate apposition, and all the knots inside the bowel.   Dr. F. H. Wiggins,[2] comparing this method and Murphy's button, pointed out the following as requiring careful attention when this method is employed : (1) The mesenteric border must be carefully approximated.   (2) The sutures must not be placed too near the edge of the intestine ; they should be placed a quarter of an inch from it, at least.   (3) Too much force must not be used in reducing the invagination, or the sutures may cut out.   (4) In closing the longitudinal incision, too much of the edges must not be turned in, or a contraction may result.
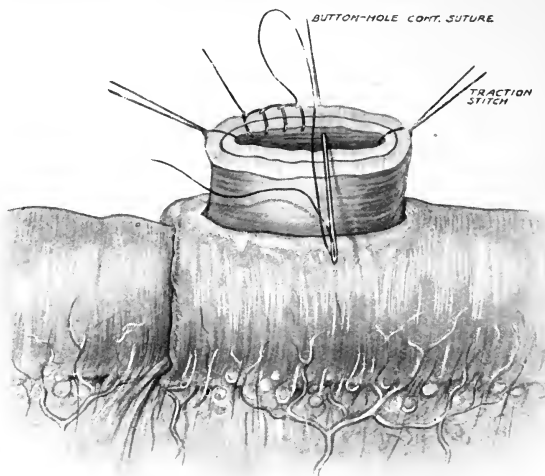
Fig. 162.   Maunsell's method.   The invaginated ends brought out through a side opening are sewn with a continuous button-hole suture.

While this method is less alluring than Murphy's button, and cannot be used so rapidly, it has certain **advantages** over it which it shares with circular enterorraphy, and certain peculiar to itself.   Thus, it needs no mechanical device, which may not be at hand just when wanted.   It requires only a few needles, silk or durable catgut.   Thus, in Dr. Wiggins's account of his own case, in which he resected six inches of the ileum for contusion and perforation, uniting the ends by Maunsell's method, he writes :[2]   "The urgency of this case was great.   The patient was in a country farmhouse.   The operation could not have been safely delayed one hour longer than it was ; consequently there was no

across the lumen of the bowel, but through only two walls, and tied the sutures as they were inserted.   He found that great care was needed to ensure that the cut edges of the peritoneal coats were equally drawn up, and that each stitch passed a good quarter of an inch below them, for the mucous membrane tends to prolapse and to conceal the peritoneal edges, which are of chief importance.

[1] If now there is any doubt about the line of suturing, a few Lembert's sutures should be added externally, especially about the mesenteric junction ; or an omental graft may be added (Stanley Boyd, *Med.-Chir. Soc. Trans.*, vol. xxvi, p. 345).

[2] *Loc. supra cit.*

time to procure mechanical devices from the city. A few instruments, a paper of ordinary sewing-needles—milliners' No. 6—and some iron-dyed silk were easily procured, and the operation was promptly performed, and the patient's life saved." Dowd[1] states that thirty-one cases of Maunsell's operation had been reported, with only three deaths, but several operators had used a few reinforcing sutures. No one of the deaths was attributable to any fault in the method, all the patients dying of shock. It is probable that unsuccessful cases have not been published.

The advantages which are claimed over circular enterorraphy are that this modification is speedier of execution, and that it gives easier command over the hæmorrhage. A third is that, when the ends are of unequal size, they can be more readily dealt with by the invagination of this method than by circular enterorraphy. A fourth is that inversion of the edges is so good that no reinforcing sero-muscular stitch is required. The chief objection to be brought against it is the additional wound through which the temporary invagination has to be made. Connell, Wiggins, and others have since devised other methods of attaining the same objects without having to make an additional wound, which is difficult to close satisfactorily without narrowing the bowel. Maunsell's suture, being a circular one, is more exposed upon the serous surface, and is therefore in more need of reinforcement than Connell's suture. Having compared this method with Murphy's button it is right that I should add that Dr. Ricketts, of Cincinnati,[2] after resecting four inches of the ileum for carcinoma, on attempting " to make a Maunsell operation," found that the distal end of the gut was so fixed, it being only five inches from the ileo-cæcal valve, that more time would be consumed than was for the good of the patient. He accordingly used the Murphy's button, which took only eight or ten minutes. The patient, who had persistently refused operation, sank ten hours later. Dr. Ricketts, while " satisfied that the button was the most appropriate in this case," is " thoroughly convinced that the Maunsell operation is the one to be used in the majority of cases."

Murphy's Button (Figs. 163 to 166). This, one of the most ingenious inventions of the last century, we owe to Dr. J. B. Murphy, of Chicago.[3] Its great advantage is the facility and rapidity with which end-to-end approximation can be effected without any sutures. The button consists of two halves. The male half has a spring flange for keeping up pressure on the intestine ends. Two springs (s s), projecting through openings in the hollow stem, act as a male thread of a screw, when the male half is telescoped within the female half of the button. When

FIG. 163. Murphy's button. A, Male half. B, Female half. P, Spring-flange. s s, Springs projecting through openings in hollow stem. At c, part of the cap of the small half has been cut away to show the circular spring which keeps up the pressure as the button does its work. The round holes in the caps are for drainage. (This and the next three figures are borrowed from Down's pamphlet.)

[1] *Ann. of Surg.*, 1902, vol. xxxvi, p. 47.
[2] *Ann. of Surg.*, vol. i, 1894, p. 473.
[3] *New York Med. Record*, December 10, 1892.

the button is used to unite resected ends of a bowel a puckering or running thread is passed round each side to and from the attachment of the mesentery, and especial care is taken to close the triangular interval which exists here (Figs. 154 and 164) by means of the return stitch. One half of the button, held as in Fig. 165, is then inserted in the intestine, and the running thread so tightened as to pucker the cut end of the intestine with sufficient closeness and tightness around the shaft of the button. The ends of the thread are then tied and cut short. The other half of the button having been secured in the opposite end of the intestine (Fig. 166), the two halves are gently pressed together, the surgeon having first made sure that both cut ends are, all along their edges, within the grasp of the button. The two halves are pressed together until it is seen that the peritoneal surfaces are held in sufficiently close and accurate contact. Dr. Murphy holds that it is needless to apply Lembert's sutures with the button between the serous surfaces.[1]

Fig. 164. *b*, Puckering thread. *a* shows the return stitch by which the interval between the two layers of the mesentery is closed—a very important detail.

Dr. Murphy[2] claims for his button that in resection of intestine for gangrenous hernia it has been used twelve times, with two deaths. In resection for malignant disease there have been thirty operations with seven deaths, these thirty including eight cases of resection of the cæcum, with but one death. With regard to two of the cases of fatal peritonitis, Dr. Murphy points out that in one the button was too large and fitted too tightly. To prevent tension the button should fit easily. In another case both ends of the intestine were found to be gangrenous at the necropsy. This is stated to have been due, not to the button, but to the length of time during which the intestine was clamped during the operation. Later one of Murphy's assistants collected the records of 750 cases of enteroenterostomy performed by
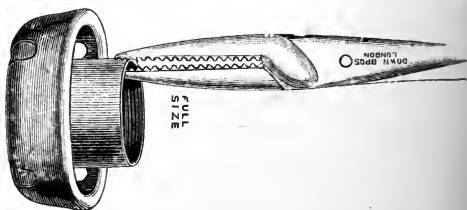
Fig. 165. Showing method of holding button for insertion.[4]

[1] The following precautions are given as to the button and its use. The edge of the cup should never be sharp, but possess a line of surface. The surface must not be too stiff, or it might produce too rapid sloughing. The locking should be easy. Unnecessary handling of the buttons should be avoided. They should be left partially unscrewed until wanted for use.

[2] *Lancet*, vol. i, 1895, p. 1040.

[3] The male half of the button is held in the same way. The figure representing the forceps holding the male half of the button has been omitted, as it shows the forceps in a wrong position. Mr. Cathcart, of Edinburgh, has kindly drawn attention to this point.

means of the button, and found the mortality to be only 19 per cent. in all the cases, and 14·4 per cent. in the non-malignant cases.[1]

The *modus operandi* of the button is based upon the following principles : (1) It retains apposition automatically—that is, without suture. Thus the danger of shock, the length of the manipulation and exposure of the intestine, the risk of infection, post-operative paralysis, and adhesions, are very greatly lessened, and an immense saving of time secured. (2) The pressure-atrophy is produced by elastic pressure ; this being uniform and continuous, the assurance of adhesions is greater and the risk of infiltration less. It produces juxta-position of the edges of the same coats, thus minimising the inter-position of fibrous tissue, and perfecting the regeneration along the line of union. As a result, the union is accomplished with the smallest possible cicatrix, and therefore must yield the least contraction of any operation. Believing that he had absolutely established the above, Dr. Murphy claimed that his button attained the best results in intestinal
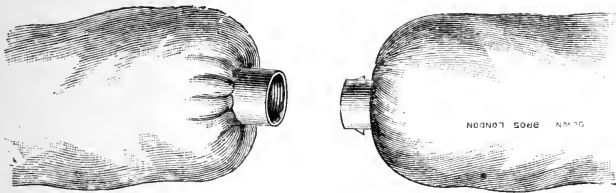
Fig. 166. Murphy's method of end-to-end approximation of divided intestine. The two halves of the button, each secured by a puckering thread, are ready to be pushed home.

approximation because it best attained the following ends : (a) Accurate contact of surface. (β) Speedy and permanent adhesion of the approximated surfaces. (γ) An opening sufficiently large for immediate purposes. (δ) A cicatrix that will not contract harmfully ; the forma-tion of a diaphragm is very rare after the use of the button. (ε) The accomplishment of all these in the most *simple* and *rapid* manner. To these may be added that the button is especially suitable when speed is imperative, and when the anastomosis has to be made in the depth of a wound, because it is not possible to bring the intestine outside or even well into the wound. I found the button very useful in enabling me to join the ileum to the adherent and atrophied ascending colon after resection of the cæcum for multiple fistulæ due to tuberculous disease ; the patient did well.

Objections. Dr. Murphy's method is so alluring in its ingenuity, the simplicity and readiness with which it can be applied are so evident, that there is some danger of its **disadvantages** [2] being lost sight of. The following appear to me to be established :

(1) Contraction of the orifice.[3] When the *modus operandi* of the button is considered this risk must always be remembered. In the

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[1] *Philadelphia Med. Journ.*, 1900, p. 1271.

[2] Dr. Murphy, in a very interesting paper on " Operations with the Murphy Button " (*Lancet*, vol. i, 1895, p. 1040), makes, I think, too light of these. Several of his conclu-sions as to contraction of the scar left by the button, fæcal impaction, and sloughing, are, it seems to me, not justified by the published cases (*vide infra*).

[3] Dr. Murphy (*loc. supra cit.*) states first amongst the conclusions at which he has arrived—" The cicatrix produced with the button does not contract." No mention is made of Prof. Keen's case given below.

words of an American surgeon who has taken much practical interest in intestinal surgery (Dr. McGraw, of Detroit), " in the operation by Murphy's button, the button becomes detached by crushing the rim of tissue around the opening of communication until it sloughs and gives way, leaving behind a granulating wound, disposed to close after the nature of such wounds." [1] A case of Prof. Keen's of ileo-colostomy, for carcinoma of the colon, by means of the button, is an instance of the truth of the above :

The button had been passed on the twelfth day, " together with a slough consisting of the rings of tissues between the two halves of the button. The patient died very suddenly of a perforating ulcer of the colon, forty-seven days after the operation, and the necropsy showed that the opening had already contracted to one-half of its original diameter.

(2) Sloughing at the line of junction, and extravasation of fæces.

(3) Septic peritonitis due to sloughing of the intestine over the button. The button may set up a limited pressure-gangrene or sloughing. In many cases this process will be limited, but it is manifestly impossible to control or limit such a process, and occasionally fatal results will be met with from this cause.

Mr. Harrison Cripps [2] mentioned a case in which the patient died in two or three days from acute septic peritonitis due to sloughing of the intestine over the upper half of the button.

(4) Retention of the button, causing obstruction.

The following show that the button may cause fatal obstruction :

Dr. R. Abbe [3] has related a case of resection of the caput coli and ascending colon for cancer in a patient aged 42. An end to end anastomosis was easily made with a medium-sized, easy-fitting Murphy button. At the end of the second day there was abdominal pain, with tympanites and vomiting. Strong desire to defæcate was futile, even with the aid of a high enema. Saline cathartics were useless. On the third day after the operation the greatly distended ileum was sutured to the abdominal wall and opened. A large amount of fluid fæces escaped with great relief. The patient died on the sixth day. The necropsy showed no peritonitis, but an empty colon below the button, and a hard plug of fæces in the button, which caused complete obstruction.

Dr. Kammerer [4] has recorded a case in which the button caused trouble by not passing in the small intestine.

The case was one of fæcal fistula, resulting from a gangrenous hernia. Anastomosis had been made by a Murphy's button. Thirteen weeks later the button had not been passed, but could easily be reached from the fæcal fistula which still persisted. Dr. Kammerer enlarged the fistula, and after much trouble succeeded in extracting the button. The patient did well for six days, when she developed symptoms of subacute peritonitis and died. The necropsy showed general peritonitis. The anastomosis had separated while the button was being removed, and the sharp edges of the incision into the bowel showed that the adhesions, even after thirteen weeks, must have been very slight. Dr. Kammerer did not believe that the peritonitis was due to a separation at this point, but any other explanation for it was not apparent.

Mr. Harrison Cripps [5] mentioned, in the discussion on colectomy, a case in which the patient died on the eighth day from perforative peritonitis caused by the button having become impacted six inches below the point of anastomosis, and having ulcerated through.

Mr. F. C. Wallis [6] records an interesting case of resection of a chronic intussusception of the small intestine, in which he used a Murphy button.

[1] *Ann. of Surg*, vol. ii, 1893, p. 315.
[2] *Loc. supra cit.*   [3] *Ann. of Surg.*   [4] *Ibid.*
[5] *Brit. Med. Journ.*, vol. ii, 1895, p. 965.
[6] *Lancet*, December 5, 1903.

Three weeks later the button gave rise to attacks of colicky pain, and had to be removed from the lower end of the ileum. Wallis thinks that the button used was too large, and he had not had any other trouble from the use of Murphy's button, which he has employed many times. A similar case is mentioned under " Gastro-jejunostomy."

(5) Kinking and strangulation from the weight of the button. This is rare, but a case of Dr. Abbe's is related of this kind : [1]

Five inches of small intestine had been resected for gangrene in a hernia. The two ends having been joined by Murphy's method, the loop containing the button was replaced, and Bassini's operation performed. Before the wound was entirely closed, Dr. Abbe looked in and noticed that the upper end of the gut was still distended. This was due to the button kinking the gut as it lay in the iliac fossa. The loop was accordingly pushed towards the middle of the abdomen, in the belief that it would settle and rest easily among the other coils. Symptoms of strangulation recurred, and forty-eight hours after the first operation Dr. Abbe reopened the abdomen and found the kink persisting, the bowel having gravitated to the lowest point in the pelvis. The patient only survived the operation a short time. It seemed that the weight of the button had given rise to the acute obstruction by sharply bending the gut. Probably this was aided by the paralysed condition of the bowel so common in these cases.

(6) Mr. Mayo Robson, in a speech at the Clinical Society, pointed out that if any error was made in applying the button, it might be impossible to unfasten it for readjustment. He stated that under such circumstances an operator, in order to set the button free, had found it necessary to excise afresh the portion grasped by the button.

(7) Another objection of a very different kind may be just alluded to, and that is, its expense, and the difficulty of always having the right size at hand. This in no way detracts from the ingeniousness of the button.

I am well aware that these cases given above are but few when compared with the large number of brilliant successes which Dr. Murphy's button has attained. It is right, however, that they should be published, as there is strong reason to believe that the button has been used on many occasions unsuccessfully, these cases never being published. Again, it is noteworthy that the failures which have been published have occurred in the hands of most skilful surgeons. I fear that the extreme ingenuity of the button, the facility with which it can be used, may tempt men far less competent to perform operations for which they are unfitted, with results that will not be made public. König, I find, has expressed the same view. Thus, " The use of Murphy's button may extend the practice of resection, and so enable inexperienced surgeons to perform these operations, but this, from the patient's point of view, is rather a disadvantage than a sign of advance." [2]

Enterectomy with End-to-Side Union. This method is sometimes very convenient, especially when the parts to be joined are of unequal calibre, e.g. when after excision of the cæcum the ileum has to be joined to the colon, or when the small intestine dilated above an obstruction has to be united to the shrunken bowel below.

This method of anastomosis is also commonly used when performing ileo-colostomy for irremovable growth of the upper part of the colon, or as a preliminary means instead of colostomy for the relief of acute intestinal obstruction due to growth of the colon, which can be resected later on.

It is better to implant the proximal in the terminal piece of intestine,

[1] *Ann. of Surg.*   *Centr. f. Chir.* No. 4, 1895.

for then peristalsis in the proximal intestine hurries the contents directly through the anastomosis instead of towards a blinded end, which might give way under pressure in spite of a lateral opening. On the other hand, when the open end of the terminal piece of intestine is closed, the peristalsis is always away from it so that no undue strain is put upon the inversion.

It is fortunate that this method allows a dilated proximal bowel to be implanted into a smaller terminal, for there is no limit to the length of the longitudinal incision which can be made in the latter. The danger of the mesenteric space only concerns the implanted end and can be easily overcome. The union is not so neat as end-to-end union, but
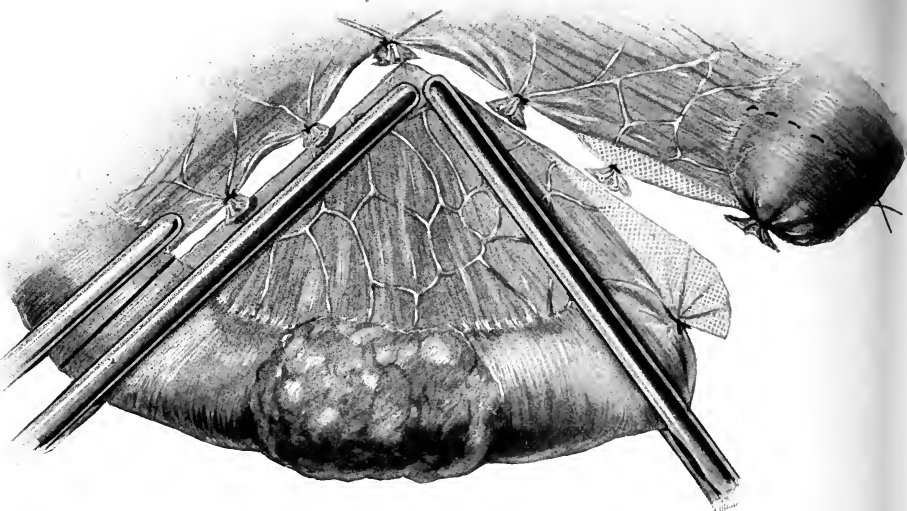
Fig. 167. Enterectomy with end-to-side union. Three clamps are applied, the distal end of the loop is crushed and tied. The mesentery is tied and the diseased loop is removed.

it is easier and, I think, safer, especially when dealing with bowel of small calibre.

Operation. A free incision through the inner and middle third of the right rectus is made. The edges are carefully enveloped with protecting pads, the diseased part of the intestine is identified and withdrawn, and two layers of packs are carefully placed around the bowel so that nothing can either leak over the wound or into the abdomen. The extent of the resection is decided and the mesentery of this part is tied in segments well beyond the disease. Sometimes a wedge-shaped piece including diseased lymphatic glands or thrombosed blood-vessels containing septic clots has to be removed. In any case fewer ligatures are required when they are placed well away from the bowel. Usually the ligatures extend along a semi-lunar or V-shaped line, the first and last ligature touching the bowel at the extremities of the loop to be resected. Two clamps are applied rather obliquely at the upper end of the loop with their points holding the mesentery on either side of the row of ligatures already described. They are placed one inch apart, and before they are locked the bowel between is emptied. At the lower

end of the loop only one clamp is applied, and half an inch below it the bowel is crushed with forceps and then firmly tied with strong linen thread (*see* Fig. 167).

When the clamps and ligatures are properly applied no bleeding occurs as the mesentery is divided a quarter of an inch in front of the row of ligatures. A pad of gauze is now placed through the mesenteric incision to prevent any soiling during the next stage.

The intestine is severed with a sharp knife just above the second clamp and one-sixth of an inch above the intestinal ligature, and the diseased part is thus removed without any spilling. The mucous membrane exposed at the remaining ends is cleansed with mops moistened with methylated spirit, and that above the ligature is removed with scissors. The lower stump is then invaginated with one or more continuous sero-muscular sutures of fine linen thread, as shown in
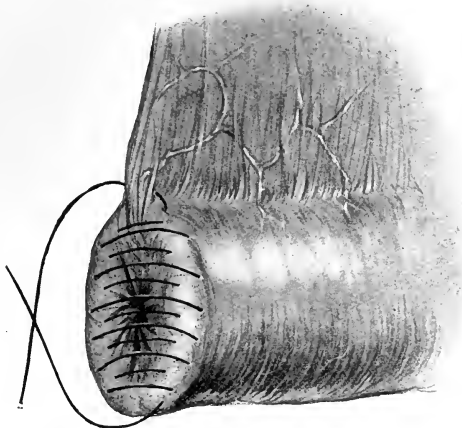
FIG. 168. Enterectomy with end-to-side union. The distal stump is buried by a continuous sero-muscular suture picking up the mesentery, which is thus drawn over the end when the ends of the suture are tied together.

Fig. 168. A clamp is then applied longitudinally near the free border of the distal intestine, with its point one inch below the blinded end. The two clamps are approximated, the anti-mesenteric border of the proximal intestine being brought into contact with the lower part of the distal pouch. This prevents rotation and kinking of the proximal bowel. A sero-muscular suture is inserted to join the two pieces of bowel engaged in the clamps. Then an opening rather larger than the open proximal end is made in the pouch. The edges of the wounds are closed with a continuous Connell suture, both knots being tied on the mucosa. Care is taken to obliterate the mesenteric gap of the proximal end. The clamps are removed and the serous suture is completed. The mesenteric incision is closed with a continuous suture (*see* Fig. 169).

Enterectomy with Side-to-Side Union. Lateral union has been so successful in gastro-enterostomy that it has been frequently adopted for intestinal anastomosis in preference to end-to-end union over which it has the following advantages :

(i) Leakage is less likely. This is a matter of experience, but it was to be expected on theoretical grounds, for plane surfaces entirely covered

with peritoneum can be brought together and the danger of the mesenteric gap thus eliminated.

(ii) The anastomotic opening is not limited in size, and is not so liable to contract. In this method there is some fear of leakage from the blinded extremities, especially the upper one towards which peristalsis forces the intestinal contents, but great care in closing these ends and making a large anastomosis reduce this danger to a minimum.

In dealing with the mobile small intestine there is usually no difficulty in getting the ends to overlap to the required extent, but in the large intestine this is sometimes impossible when an end to end union can be made without tension. For a satisfactory lateral anastomosis the ends
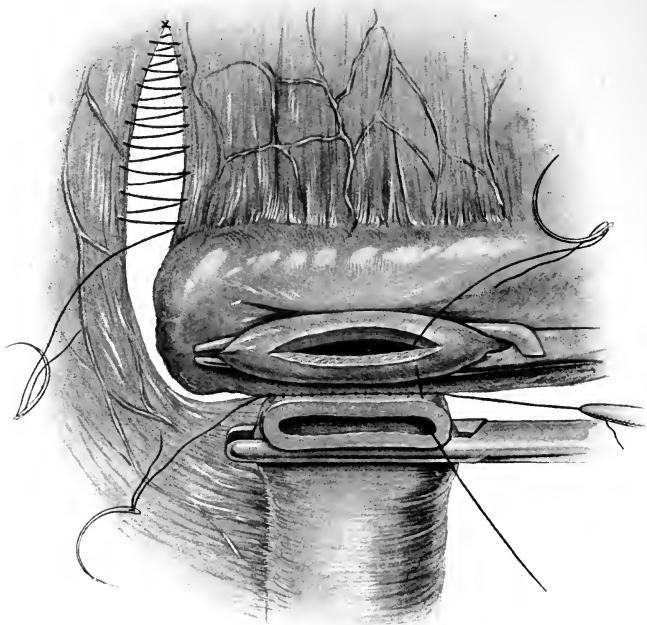
Fig. 169. Enterectomy with end-to-side union. The open proximal end is joined to the side of the closed distal end; sutures are shown at the anastomosis and closing the mesenteric flap.

must overlap about three inches, thus demanding about six inches more bowel than is required for end-to-end union.

Operation. The preliminary steps of the operation are the same as those described under End-to-Side Union. When the mesentery has been tied and divided, and a pack placed immediately behind the bowel, the two ends of the loop of intestine are crushed and tied, and then divided between the ligatures and clamps which have been applied half an inch nearer the disease (see Fig. 167). The diseased part is thus removed without any appreciable spilling. The mucous membrane projecting beyond the ligatures is cleansed and removed with scissors, and each extremity is invaginated by two purse-string sutures, which also serve to bring the mesentery over the blinded end. These sutures are respectively half an

inch and one inch away from the tied extremity (*see* Fig. 170). Lane's intestinal clamps are then applied with their points at least an inch away from the blinded extremities. Each part included in the clamps is emptied as far as possible before the clamps are locked. The pouches
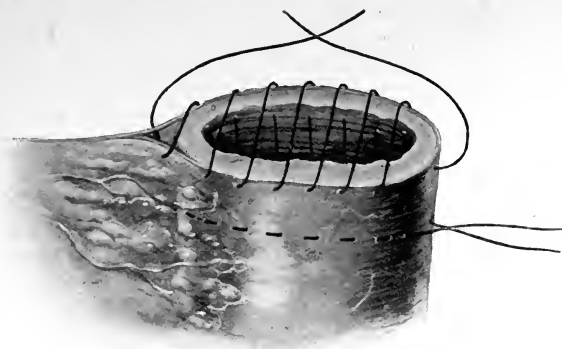
Fig. 170. Another method of closing the end of divided bowel.

are at least three inches long. Packs are carefully placed to isolate the pouches, and an anastomosis is made just as in gastro-jejunostomy, two continuous sutures of fine linen thread being used (*see* Fig. 169). When the anastomosis has been completed, the mesenteric wound is closed with a continuous suture and all rough edges are buried as far as possible (*see* Fig. 171).
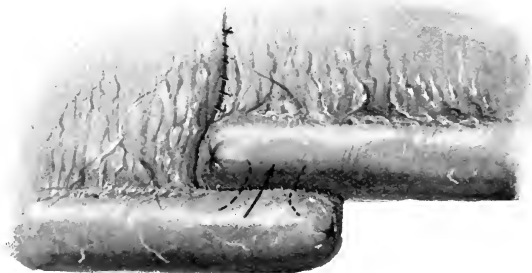
Fig. 171. Enterectomy with side-to-side union.

COLECTOMY

The general indications for resection of bowel have been discussed (p. 271). New growth, generally carcinoma,[1] is by far the commonest indication for colectomy.

CARCINOMA OF THE COLON

Diagnosis. As most of the subjects of carcinoma of the colon die from the local effects of their growth and not from dissemination, it is

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[1] Corner and Fairbank have related a fatal case of secondary resection of a sarcoma of the colon, which had produced intussusception in a boy aged 9. The growth was first noticed during the reduction of the intussusception about two months earlier. Only eleven cases of sarcoma of the colon were then recorded (*Pract.*, June 1902).

very important to diagnose and operate for this condition while the growth is still removable, and especially before the intestines become distended and damaged from increasing obstruction. Many hospital patients do not seek advice until intestinal obstruction develops. When a patient approaching or past middle age complains of constipation, perhaps alternating with occasional attacks of spurious diarrhœa with offensive stools, flatulent dyspepsia, griping pains, wasting, and anæmia, a growth of the colon should be suspected, and the whole course of this bowel examined carefully. In this way a growth may often be discovered before distension develops. Rectal and bimanual examinations of the pelvis and of both loins may enable the surgeon to feel a tumour. Visible peristalsis is a very valuable sign, and gurgling at one spot may sometimes terminate a griping attack, and indicate the probable site of the disease. The passing of blood and slime generally indicates that the growth is below the transverse colon. Sigmoidoscopy and X-ray examinations, after a bismuth meal or similar enema, may reveal and localise the obstruction.

Vomiting may not occur until quite late, and then may herald the complete obstruction that is too often allowed to occur. In cases of doubt or of strong suspicion, an early exploration is strongly advised, for with early removal of the growth the prognosis is good. When an operation is undertaken before obstruction develops the disease can be cured by a single operation, much time and trouble saved, and repeated operations avoided.

Indications for Resection. In deciding whether the growth is removable or not, the following *clinical* points are important :

(*a*) *Local.* The smaller the size, the more definite the outline and the more movable the growth, the more likely is it to be removable. Therefore mobility is of importance in pointing to the absence of adhesion. The absence of tenderness and the signs of inflammation are also important. When suppuration has occurred around the growth the dangers and difficulties of resection are greatly increased. The adhesion of the growth to the parietes is not so important as it used to be considered, for the colon can be mobilised. Adhesion and especially invasion of small intestine, stomach, pancreas or kidney are more serious, but may be met occasionally by careful separation or resection of a part of the invaded viscus. Signs of growth in the liver, especially nodular enlargement. Ascites or nodules of growth felt on pelvic examination indicate invasion of the peritoneum. In many cases it is only possible to decide if a growth is removable after opening the abdomen.

(*b*) *General.* Amongst the general points that must weigh with the operator are the strength and nutrition of the patients, their fitness, to bear a severe operation and to supply the needful plastic repair.

Another point having a most important bearing upon the advisability of performing resection for malignant disease is whether this is complicated by *obstruction, tympanites,* &c. If there is one point which published (and still more the unpublished[1]) cases prove, it is that the occasion in which it is right to submit a patient, the subject of intestinal obstruction, to such a prolonged operation as resection and suture or anastomosis of the resected parts must be of the very rarest.[2] This is

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[1] Quite as instructive in their way. *Nec silet mors.*
[2] Dr. Ricketts (*Ann. of Surg.*, vol. i, 1894, p. 472) relates a case which was most favourable for resection. The growth, only of the size of a hickory nut, was easily found,

plain from the usual state of the patient in these cases, and the condition within the abdomen with which the operator has to deal. Is a patient, usually past middle life, whose strength and powers have been sapped for days or weeks by the nausea, inability to take food, vomiting, distension, and all the distress which forms part of a miserere of the later stages of chronic intestinal obstruction, in a fit state to go through a prolonged operation, and to supply after it the plastic repair which is needful for success ? There can be but one answer here. And it is the same when we examine those local conditions which will have to be faced by the operator. The distension of the intestines, and the difficulty of keeping them within the belly, prolong the operation, add to the shock in an exhausted patient, and, by rendering asepsis most difficult, diminish his chances still further. Another point, viz. the condition of the intestine above and below the obstruction, is a strong argument against resection and union of the intestine when obstruction is present. Above, the intestine will be distended, congested, softened, and septic ; below, empty and shrunken. The difference in the size of the two sections may prove a serious difficulty in their union, but a graver objection to uniting them now is the fact that for the present both are paralysed ; and though this can be met, in a measure, by emptying the contents of the upper bowel when this is cut through about the growth, yet every one familiar with these cases knows perfectly well that if the obstruction be low down it is extremely difficult to empty the bowel above sufficiently in the short time available. Much of its contents are left behind ; the condition of obstruction largely continues, with its results—a continuance of toxic absorption ; and if the contents of the intestine are passed on from above, too often they find the junction of the resected parts, made in softened, inflamed tissues, unfit to bear the strain.

Dr. Elliot [1] states that the mortality of primary resection and immediate suture in these cases is at least 50 per cent. even in the hands of the best surgeons, and in some hospitals it is as high as 85 per cent. Peritonitis is the chief cause of death, and this is nearly always due to the fact that the most perfectly placed sutures or mechanical devices do not hold. Another cause of death is shock, partly due to an unnecessarily long operation. *Where obstruction is present, resection should be deferred until one of the following steps has been adopted.*

(1) **Colostomy** above the obstruction and well away from it. If possible the ascending or transverse colon should be selected, for cæcostomy is not so satisfactory on account of frequent and fluid discharges. Mr. Paul, with his wide experience, advocates a right lumbar colostomy in these cases, because the opening being posterior is well removed from the site of incision for a radical operation, and he thinks it safer than an anterior operation.

I prefer an anterior lumbar colostomy which can be performed easily enough after incising the peritoneum to the right of the ascending colon. A transverse colostomy is often the most convenient. An anterior incision enables us rapidly to explore the abdomen and to ascertain the cause and site of obstruction and the presence or absence of secondary

drawn out, and resected. The ends were united by a Murphy's button. The ileum being enormously distended with fæcal fluid, owing to the patient having deferred operation till the last, about a gallon was withdrawn by an incision, which was closed by Lembert's suture. The patient sank ten hours later.

[1] *Ann. of Surg.*, 1905, vol. xlii, p. 688.

growths in the liver or peritoneum. In this way we can avoid a catastrophe in overlooking a volvulus or an obstruction of the lower ileum, and we can at once decide if resection of a growth is likely to be feasible later on.

Colostomy is no doubt safer than short-circuiting in the presence of complete and late obstruction with intestinal paralysis, especially in old people. When the growth is near the ileo-cæcal valve or in the ascending colon, short-circuiting is generally to be preferred for the fluid frequent and irritating discharges from the cæcum or ileum are very objectionable.

(2) **Short-circuiting,** such as ileo-colostomy. This can be very rapidly performed, and it need not interfere with a subsequent resection, but, on the contrary, it often lessens the work to be done at the second operation, and thus diminishes the risk. This is particularly applicable to growths of the ileo-cæcal region. At the primary operation the ileum is anastomosed to the transverse or sigmoid colon, and a fortnight later the growth is removed and the open ends are closed, there being no need to unite them as the channel has been already established. For these reasons, unless the patient is very ill, I prefer short-circuiting to colostomy as a preliminary to resection. In the presence of complete obstruction with paralytic distension this is not so likely to save life as colostomy, but in other cases it is cleaner and often renders the subsequent resection somewhat easier and safer.

The following case illustrates this method of treatment and has many interesting features :

Carcinoma of the Sigmoid. Acute Intestinal Obstruction. Anastomosis of the Ileum to the Pelvic Colon. Secondary Resection. Recovery. Secondary growths in liver after four years.

Mrs. D., aged 61. A patient of Dr. Brookhouse, of Bromley. The patient first consulted Dr. Brookhouse for vague abdominal pains on January 11, 1910. Dr. Brookhouse examined her carefully and failed to discover any abnormality. The patient said that she had had indigestion and pains in the abdomen since about August 1909. She looked very well. There was no history of the passing of blood or mucus. The bowels were irregular and practically always constipated. The patient was seized with more severe pain on the *morning of May* 8, 1910. Since then the bowels have not been satisfactorily opened in spite of opening medicine and enemata. Three small lumps only were brought away on the 9th. The patient has had nothing but water by the mouth since the onset of the pain. The pain is very severe and of a colicky nature. It seems to be worse on the right side of the abdomen where Dr. Brookhouse found a distended piece of bowel, probably the cæcum. He was not able to find any visible peristalsis, but on putting his hand upon the distended part a gurgling noise passed across the abdomen towards the left flank. Nothing abnormal could be found on rectal examination. The temperature was 99°. The patient was not sick once, but there was no inclination for food. The tongue had become increasingly dry. When I saw her on May 11, about six o'clock, the abdomen was generally distended. This was more marked in the right flank. No shifting dulness could be made out and no tumour. The pulse was about 100, good and regular. The patient's general condition was fairly good.

Operation. The abdomen was opened through the lower part of the right rectus. The cæcum was found to be distended with fæces, and the small intestine was congested and slightly distended. A growth was found in the descending limb of the sigmoid loop. It was large and congested, measuring about three inches long, and it was constricted at the middle. The bowel below it was quite empty. This was brought into the wound, and a lateral anastomosis was made between it and the ileum, six inches from the cæcum. The opening in the pelvic colon was placed as low down as possible, about four inches below the growth, in order to allow plenty of room for a secondary resection later on. The abdomen was closed, catgut being

used for the peritoneum and fishing-gut mass sutures for the remaining layers. A small wick of gauze was placed in the lower angle of the wound. The patient bore the operation well. By ten o'clock she had passed a little flatus and blood. A tube was left in the rectum to prevent distension of the bowel with gas.

For the first ten days after the operation the bowels opened freely from eight to nine times a day. Later the bowels acted very comfortably and regularly once a day.

Second Operation. June 26, resection was performed at the nursing home. The abdomen was opened through the lower part of the left rectus. There were a good many adhesions in the pelvis and on the right side of the abdomen, especially near the old incision. The ileum above the anastomosis had dilated and thickened to a considerable extent. No secondary growths were felt in the liver or in the lumbar, mesenteric, or iliac glands. The growth, which had got considerably smaller since the first operation, and the anastomosis were adherent to the parietal peritoneum on the brim and also to the left ovary which was grey and suspicious looking. The left tube and ovary were removed, and an incision was made in the parietal peritoneum to the left of the sigmoid. This rent was enlarged and the sigmoid was freed by gauze dissection until the iliac vessels and the ureter were seen and displaced backwards. The ovarian vessels were tied and divided. The descending colon was freely mobilised and gauze packs were passed into the pelvis and behind the growth in the iliac fossa and the left loin. A large gauze roll had been used earlier to keep the small intestines from the seat of the operation. The abdominal wall was carefully protected with gauze. The bowel was clamped four inches above and two inches below the growth. An attempt was made to find the vessels in the mesentery, but the latter was so laden with fat that they could not be identified. A large Moynihan forceps was used to clamp the mesentery in an oblique manner. One blade was made to pierce the mesentery close to the bowel at the upper line of proposed section and was passed obliquely downwards and inwards, care being taken to avoid the ureter and the superior hæmorrhoidal artery. Two supple clamps were then applied across the bowel one inch below and above the two clamps already mentioned. The bowel was then divided three-quarters of an inch above the lowest clamp and three-quarters of an inch below the upper one. The mesentery was also divided, and the loop of bowel containing the growth was thus removed, clamped at both ends. The open ends of the bowel were carefully cleansed and swabbed over with an antiseptic lotion and covered with gauze, while the rent in the mesentery was sutured with linen thread. When this had been nearly closed the mesenteric clamp was removed. A little bleeding ensued from a vessel which had been missed by the suture. An end to end union was then made by a direct suture, the latter half of the circle of sutures being passed after Connell's method. The circle was completed at the free border, and the knot was placed inside the bowel. A sero-muscular suture was then used for reinforcing purposes, and also large appendices epiploicæ were used to cover the suture line. There was a great deal of oozing from the iliac fossa, and there was some free fluid in the peritoneal cavity at the beginning of the operation. It was therefore decided to drain the abdomen at the lower corner of the wound, which was otherwise closed in layers in the usual way. The operation lasted nearly two hours, but the patient bore it well and was not suffering from shock late in the evening. On the fourth day the temperature went up to 102°, the bowels were opened about twenty-five times, and some fæcal matter appeared in the wound. The abdomen was mobile and not distended. The temperature and irritability of the rectum soon subsided. The patient recovered completely in spite of a troublesome fæcal fistula which closed spontaneously. She was quite well, three and a half years after the resection, but she died of secondary growth of the liver about nine months later.

(3) Another method is to bring the affected coil outside if this be not too tied down by adhesions, keep it out by means of a rod passed beneath it, a Paul's tube being then tied into the upper end to drain it. Some days later, when the patient's condition admits of it, the growth is resected and the two ends united either at once or at a subsequent date. Only the mesenteric two-thirds of the bowel may be united, and the remainder left to close spontaneously as the bowel gradually sinks back into the abdomen in the usual way.

There are many objections to this method. (*a*) A sufficiently wide resection, especially as regards the mesentery, is difficult to accomplish. (*b*) It is difficult to unite the divided ends, without tension, and the anastomosis is not supported by the peritoneum of neighbouring coils of intestine, so that a fistula generally occurs. (*c*) The prolapsed intestine if left out more than a few days gets so very congested and sodden that it is not suitable for sewing. (*d*) The method is not often available except for growths of the sigmoid or transverse colon, although other parts may be mobilised sufficiently to allow the growth to be delivered.

Once the growth is outside there is no valid reason against removing it at once, for this takes very little time and the peritoneum can be protected by surrounding the base of the loop with gauze. The mesentery can be quickly tied, and two Paul's tubes inserted into the cut ends of the colon. No attempt should be made to join these together at this stage, for it is doomed to failure.

The following case illustrates some of the advantages and disadvantages of this method :

Carcinoma of the Sigmoid. Acute on Chronic Intestinal Obstruction. Colostomy with Delivery of the Growth. Resection five days later. Secondary Anastomosis. Pelvic Abscess. Recovery.

Mrs. P., aged 46, says that she has suffered for many years from constipation and during the last few months this has been getting worse. She has not noticed any blood or slime. A fortnight ago she was seized with severe abdominal pain, and since then she has had no relief. The bowels have not been opened nor has she passed any flatus. She has taken opening medicine without avail, generally vomiting it. She has had one enema without effect. She has taken very little food and has had very little sleep. She has been in bed all the time except for two days at the early part of her illness. The pain and sickness are not quite so bad now as they were. She was last sick on January 1 in the afternoon, bringing up brown offensive material. She was sent to Guy's Hospital with her doctor's card. The abdomen was greatly distended, and three times while the patient was watched during half an hour visible peristalsis could be seen about the position of the cæcum. The patient was then suffering from severe colic. She had shifting dulness in the flanks. The abdomen was neither tender nor rigid. The temperature was subnormal. Chronic intestinal obstruction, due to growth of the colon, was diagnosed, and it was thought probable that it was somewhere about the transverse colon. Rectal examination had revealed no growth in the pelvis.

Operation on January 2, 1911. The abdomen was opened by displacing outwards the lower part of the right rectus. The cæcum was at once seen to be distended, and the small intestines were also very distended. A large amount of clear fluid escaped from the abdomen. On passing the hand into the pelvis a growth was felt about seven or eight inches from the anus. It was a small contracting carcinoma. The bowel above it was greatly distended. It was seen that although it would be possible to make an anastomosis between the ileum and the bowel below the growth, it would not then be possible to perform a secondary resection of the growth. Moreover, the patient's condition was bad, although the pulse was only 80 before the beginning of the operation. Therefore a small muscular separation incision was made in the left flank, and a loop of bowel containing the growth was brought out through this wound and fixed in position by means of a Spencer-Wells forceps passed through the mesentery and clamped on a pad. The incision was then closed and covered with a sealed dressing. A roll of gauze was wrapped around the base of the loop of sigmoid, and then a Paul's tube was tied into the distended bowel one inch above the growth. The patient was infused about four pints during the night. She made very rapid improvement and regained her natural colour, her face becoming much fuller. She ate and slept well.

On January 7, 1911, an attempt was made to remove the growth, which was projecting, with a cautery after painting it with cocaine 5 per cent. solution, but the patient complained of pain, and therefore a little A.C. was given. The project-

ing loop of bowel was then removed, the lower limb being divided first about two inches below the growth, then the mesentery, a wedge of which was removed, and lastly the bowel about three inches above the growth were divided. The vessels were tied and the two ends of the bowel were sewn together, starting at the mesenteric border and proceeding in each direction towards the free border, leaving an aperture just large enough to admit a small Paul's tube, which was tied in. The operation lasted an hour. The patient bore it well. Two days later the tube was removed.

About three months later, the colostomy not closing, an operation was done. The intestinal ends and an inflamed mesenteric mass were removed, and end to end union was made. The patient was well two years later.

ANATOMICAL AND PATHOLOGICAL POINTS

For the sake of convenience the large intestine is divided into several portions, and it is necessary briefly to state exactly the limits of the various portions.

The **cæcum** is only that part below the ileo-cæcal orifice, the **ascending colon** is the part above this deeply placed in the loin and nearly always without a mesentery. It is about five to eight inches long, varying with the position of the cæcum, and it extends upwards as far as the liver. The **hepatic flexure** is the abruptly bent portion extending forwards and to the left over the anterior surface of the right kidney and second part of the duodenum below the right lobe of the liver and the gall-bladder. It has no mesentery.

The **transverse colon** is a long and movable loop of colon, about twenty inches long, extending between the hepatic and splenic flexure. The length of its mesentery and the position of its central portion varies greatly. The **splenic flexure** is the acutely bent part lying deeply in contact with the tail of the pancreas, lower poles of the spleen and kidney. The **descending colon** is about five inches long and extends between the splenic flexure and the back part of the left iliac crest. It only occasionally has a mesentery.

The **iliac colon,** five to six inches long, extends from the descending colon at the posterior part of the crest of the ileum to the front of the left psoas muscle at the side of the pelvic brim. It has no mesentery, but lies in contact with the iliac fascia. In the old text-books this was described as a part of the sigmoid colon.

The **pelvic colon,** about sixteen to eighteen inches long, extends from the iliac colon to the rectum, which begins opposite the middle of the sacrum. It usually forms a long loop with a narrow base, and is so freely movable that its position varies a good deal. It usually lies in the pelvis, and first dips down along the left side of this cavity and then passes to the right, and ascends and turns inwards to the middle of the sacrum. Its mesentery is attached along a curved line extending from the middle of the left psoas upwards and inwards to the bifurcation of the left common iliac artery, and then running downwards and inwards to the middle of the third piece of the sacrum.

The **rectum has no mesentery,** but is partly covered by peritoneum in its upper two-thirds, at first at the sides as well as in front, and lower only in front. It is only five to six inches long. In the old text-books the rectum was described as eight inches long and commencing at the left sacro-iliac joint. This clearly included the lower part of the pelvic colon.

Several points in the anatomy and pathology of the colon make resections here somewhat more difficult than in the small intestine.

(i) **The absence of a mesocolon and the resulting awkward position and immobility of certain portions of the colon,** especially the ascending

and descending colon, used to hamper resections and union of these parts, but fortunately they can be mobilised by gauze dissection after dividing the reflections of the peritoneum extending outwards from them to the flanks. No important vessels are divided, for all these reach the colon on its mesial aspect.

In this way the diseased part can be brought outside the abdomen before the bowel is divided, and contamination of the wound avoided. Moreover extensive resection can be made, and the bowel above and below united without tension. The large mesocolic space can be covered with peritoneal flaps and the bowel thus completely surrounded by peritoneum for end-to-end union if necessary.

The splenic flexure, especially if adherent to the spleen, kidney, or flank due to inflammation round the growth, may be very difficult to free and deliver. Sometimes the hepatic flexure presents similar difficulties and may be adherent to the second part of the duodenum or to the pancreas. The gall-bladder, when adherent, may be removed with the growth.

A growth of the lower part of the pelvic colon often presents great difficulties, especially in the preservation of an adequate blood-supply to the rectum, and in making a satisfactory anastomosis in the pelvis.

(ii) **The blood-supply of the colon** presents some difficulties which can be avoided by an accurate knowledge of the distribution and anastomosis of the blood-vessels. The ileo-colic artery supplies most of the lower six inches of the ileum, the cæcum, appendix, and some of the ascending colon. The right colic is often a small and variable artery which supplies the ascending colon. It arises from the superior mesenteric just above the origin of the ileo-colic, but it often arises in common with or from the latter. The middle colic supplies the transverse colon and some of the hepatic and splenic flexures. The left colic supplies the descending colon, some of the splenic flexure and some of the iliac colon. The sigmoid arteries, of which there are generally two, supply the sigmoid loop and the iliac colon. The superior hæmorrhoidal supplies the pelvic colon and the upper two-thirds of the rectum. The ileo-colic, right colic, middle colic, and sigmoid arteries anastomose fairly freely, so that the division of one main trunk or several subsidiary branches need not lead to sloughing if the anastomosing arcades are not obstructed. But there is no arcade and but little anastomosis in the wall of the bowel between the sigmoid and the superior hæmorrhoidal arteries, so that especial care is required in this locality. When tying the inferior mesenteric artery it is clearly safer to apply a ligature above than below the lower sigmoid artery, for then the nutrition of the lower part of the pelvic colon is much safer. When the ileo-colic artery is tied the nutrition of the lower six inches of the ileum is compromised, therefore this piece of bowel ought to be removed with the cæcum (*see* Fig. 172).

(iii) **The lymphatic drainage of the colon.** A knowledge of this is very important for the satisfactory radical operation for carcinoma of the colon, which is by far the commonest indication for resection. Here, as elsewhere, it appears necessary to remove the corresponding lymphatic vessels and glands in one piece attached to the primary growth. Jamieson and Dobson,[1] by their anatomical studies of the lymphatics of the colon, have placed our knowledge on a scientific basis, and pathological observations by Clogg[2] and others on the spread of carcinoma

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[1] *Lancet*, 1907, vol. i, p. 1137. *Proc. Royal Soc. Med.*, *Surg. Sect.*, 1909, vol. ii, p. 149. [2] *Lancet*, 1908, vol. ii, p. 1007.

of the colon have added valuable information. On the whole the course of the lymphatic vessels draining any part of the colon corresponds with that of its main arteries, and the lymphatic glands are arranged as follows (*see* Fig. 172):

(*a*) The epicolic in the appendices epiploicæ and upon the surface of the bowel. (*b*) The paracolic in the mesocolon and lying near the
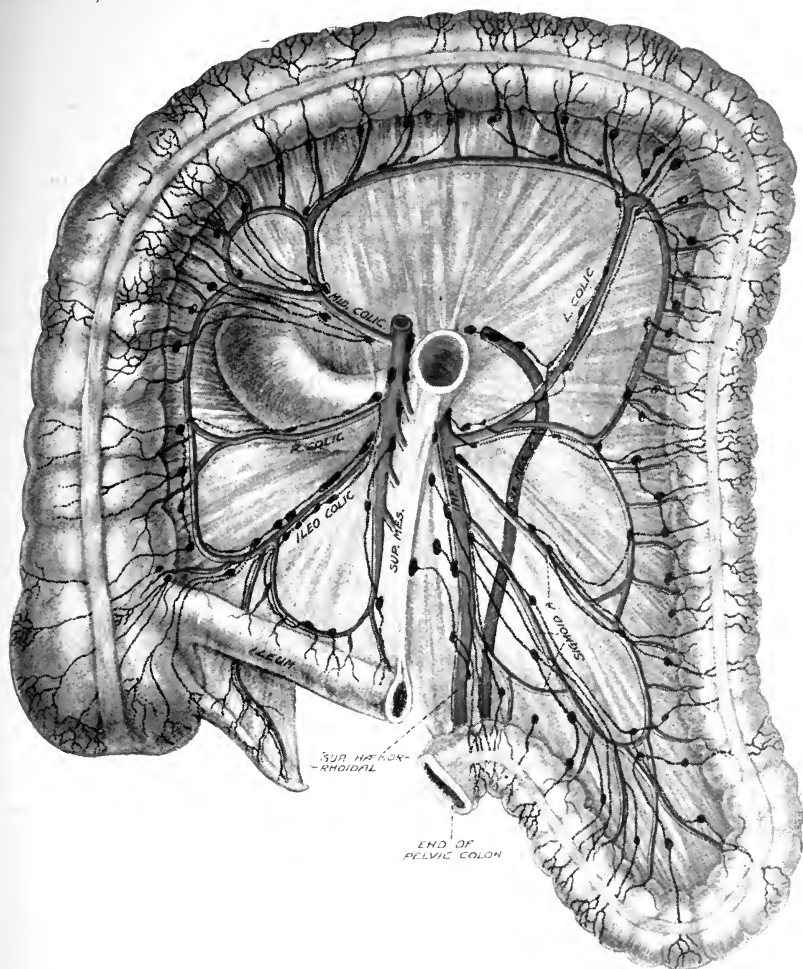
FIG. 172. Showing the arteries and lymphatic vessels of the colon. (Modified from Jameson Dobson.)

mesenteric border of the bowel. (*c*) The intermediate, lying upon the main blood-vessels about half-way between the spine and the bowel. (*d*) The main glands around the origin of the main artery.

As a rule the *intermediate* and especially the *main* groups of glands only receive lymphatic vessels from the more peripheral glands, but occasionally some vessels may run to them directly from the intestines, especially from the lower part of the colon.

The glands of the main group communicate freely with the central abdominal glands about the vena cava, so that if they are much enlarged and hard the prospects of permanent cure are not good; but many enlarged glands are only inflammatory, so that some caution is required in deciding whether resection should be undertaken. Theoretically all the four groups of glands should be removed with the primary growth, but less extensive resections have given good results because (1) glandular infection and dissemination are somewhat slow in carcinoma of the colon. This is especially true of annular growths of the pelvic colon, which soon cause obstruction and call for early attention. But softer and ulcerating growths which do not obstruct, notably those of the cæcum and ascending colon, have often infected the lymphatic glands extensively before they come to operation. (2) Whenever the intermediate glands are enlarged an attempt should be made to remove the lymphatic area with the primary growth. In the pelvic colon a more limited resection of the bowel and mesentery may be undertaken especially in old and feeble patients, when the growth is early and the lymphatic glands are not enlarged. As carcinoma spreads by permeation along the lymphatic spaces in the wall of the bowel without obvious naked eye evidence, as shown by Handley and Cole, it is necessary to remove at least three inches above and two inches below the growth. Mr. F. T. Paul,[1] in his valuable address before the British Medical Association, makes the following very important remarks upon cancer of the bowel, " a disease which usually first threatens life by mechanically interfering with the functions of the alimentary canal. We need therefore to consider each case from the two sides, mechanical and pathological, and often it is necessary to direct our treatment to the relief of the mechanical obstruction before we can attempt a cure for the malignant growth. But whether we design to give relief only or to try to obtain a permanent cure, the selection of a particular operation is not merely a matter of clinical experience. The underlying malignancy and the pathological problems involved by it must not be lost sight of, and especially must we take into consideration the varying degrees in malignancy exhibited by cancerous growths in the bowel. On this rests the expectation of life in most of our patients when proper steps are taken to avoid a fatal issue by stenosis. We trust to our surgical instinct, combined with careful clinical investigation into the patient's constitutional condition, to guide us as to his fitness to bear an operation of a certain magnitude, but we must rely entirely on information obtained from pathological sources in estimating the real value of the operation and frequently in deciding its limits. Of what use is it to submit a patient to a long and dangerous operation if his prospect of life on recovering from it is little better than he would have obtained by a simple colostomy ? Or, again, why undertake an extensive excision of mesentery for the removal of glands which, in all probability, are not infected ? It is therefore of paramount importance that surgeons should familiarise themselves with the characters of the different kinds of cancer met with in various parts of the body, as so much depends upon the behaviour to be expected from each kind. This is especially true of intestinal cancer. In no other part of the body is there a greater variation in the degree of malignancy than in the bowel."

[1] *Lancet*, 1912, vol. ii, p. 217.

Varieties of Cancer of the Bowel.[1] "The three varieties of carcinoma are : (1) the large soft fungating 'encephaloid' type ; (2) the small hard 'scirrhous' type ; and (3) the infiltrating 'colloid' type. All may be said to be primarily columnar-celled growths originating in the intestinal glands, and all ulcerate ; but they follow different paths of evolution, and attain different degrees of malignancy which it is important to recognise. The scirrhous variety is always unmistakable. It produces the hard ring stricture of the bowel, and is more common than colloid cancer, but much less frequent than the soft fungating type. This latter may usually be as easily distinguished from the colloid form of growth by the following characters : It is softer to the touch. There is a good deal of fungating growth within the bowel, but generally not much solid infiltration of the bowel wall. There are usually numerous large soft glands in the neighbouring mesentery, which are septic and not malignant. In colloid cancer, on the other hand, there is a hard-edged ulcer with no fungation. There is dense hard infiltration of the bowel wall, often attaining a thickness of from one to two inches, and giving it a solid feel. The glands, if affected, are not soft, but hard and glistening."

Misconceptions regarding Cancer. "Misconceptions exist regarding the nature of these different tumours. In the first place, some seem to forget that 'scirrhous' and 'encephaloid' are merely terms of clinical or macroscopic significance, convenient when properly used, but otherwise very misleading. Almost any histological variety of cancer may take on either character without change of cell type. Even in the breast scirrhus does not imply acinous growth, as either round-celled acinous cancer or columnar-celled duct cancer may present this clinical feature. Some speak and write as though the term 'scirrhous' was equivalent to mammary cancer, and consequently that a scirrhous type of cancer in the bowel means a cancer histologically resembling breast cancer ; whereas no form of bowel cancer could be identical with a breast growth any more than bowel and mammary tissue could be identical. They may, and do, present similar clinical characteristics, and a hard ring stricture of the colon resembles a breast scirrhus, or a thyroid scirrhus, or any other scirrhous in its hardness, in its tendency to cell degeneration, to slow but inveterate growth, to lymphatic infection, and difficulty in complete eradication, but histologically its affinity is to columnar-celled mucous-secreting epithelium and not to the specific gland tissue of the breast.

"The really important misconception, however, concerns the relative malignancy of the three varieties of cancer. Usually the big, fungating, encephaloid type of growth is regarded as the most malignant ; the colloid as being intermediate, and the scirrhous, or ring stricture, as the most benign. This arrangement is entirely wrong and out of accord with clinical experience. The colloid is the most malignant type, the ring stricture comes next, and the fungating type is the best—it being one of the least malignant kinds of cancer met with in the body.

"It is a clinical fact of considerable importance, to which I have often referred at our local medical society, that the up-growing forms of cancer are essentially less malignant than the down-growing, ulcerating, and shrinking types.

[1] Paul, *loc. cit.*

" The most common sites for the fungating type of growth are the rectum and cæcum, though it often occurs in the sigmoid, and occasionally at any other part of the large bowel. Colloid cancer chiefly selects the rectum, and ring stricture the sigmoid, though neither is limited to these regions."

Influence of Pathology on Surgery.[1] " If a surgeon when operating takes the foregoing pathological details into consideration, they will often influence him considerably in his decision as to the nature and extent of the .operation. Thus, if the growth be of the fungating type, recognised by its softness, bulk, situation, character of gland infection, &c., he would, on the one hand, feel justified in removing the tumour without necessarily interfering with any tissue much beyond the visibly affected area ; or, on the other hand, if the risk to life seemed too great to allow of this being done, he would be encouraged to hope for a reasonably long period of relief by short-circuiting or colostomy. If the tumour prove to be massive and solid, and especially if there be evident glistening gland or peritoneal infection, or if the growth be in the rectum and can be felt as an abrupt hard-edged ulcer without fungation, then the case is one of colloid cancer, and the outlook would be recognised as discouraging. When a wide and thorough removal appeared warranted it might be undertaken ; but as the prospect is never good in colloid cancer, either for excision or temporary measures, less risks to life should be accepted. In the case of ring strictures, always easily recognisable, the indication is to excise more widely than one used to think necessary, and to remember that it is in this type of growth we have the best reasons for following up the path of lymphatic infection."

OPERATIONS

(1) **Paul's**[2] **Operation.** In honour of Mr. Paul's long and valuable experience and very successful results, I venture to quote his remarks and description in full, although my own experience of other methods makes me unable to share Mr. Paul's pessimistic views concerning them. I believe that the same skill and perseverance, devoted to these methods with the resulting improvements of technique, will enable us to secure as good results, with far less inconvenience to the patient and more satisfaction to the surgeon.

" I did my first colectomy by the glass tube method just twenty years ago. At the time of publishing it [3] I narrated six other cases to show how this method had been led up to by previous unfavourable experience with primary suture and buttons, which proved to be accompanied by a heavy mortality. Since 1892 I have adhered to the same technique, and with very good success. Only at one period, when I imagined I had become clever enough to obtain primary union, did I abandon the tubes and go back to suture. I did one case in this way at the infirmary and one in private practice. Both died, the latter being the only fatal case in the Table, and the former sharing this unenviable distinction with only one other patient. No doubt the time will come when a better method than bringing out the ends of the bowel and draining them by means of glass tubes will be invented ; but I doubt if I shall ever again excise tumours of the colon in any other way, as I know this can be undertaken with a very low mortality. The

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[1] Paul, *loc. cit.*   [2] *Lancet,* 1912, vol. ii, p. 224.
[3] *Liverpool Med.-Chir. Journ.,* 1895.

operation is not a pleasant one for the patient, and the cure is delayed, but the final result is good, and, after all, that is what should appeal most to us and to our patients.

" Very shortly I will describe the original operation again. In most cases the tumour will have been located before it is· undertaken. If not, a preliminary incision in the middle line below the umbilicus will be necessary, and usually this will not be suitable for the removal of the growth. One needs an incision about six inches long, conveniently placed over the position of the bowel to be excised. Having made this, and packed off the neighbouring viscera, the bowel is loosened from its attachment to the neighbouring parieties by an incision in the parietal peritoneum, especially in the cæcal and sigmoid regions. By means
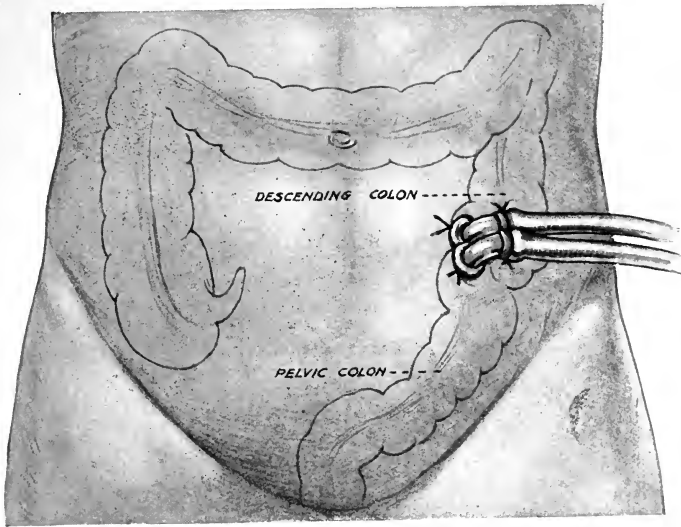
FIG. 173. Paul's method of resection of carcinoma of the colon. The growth is removed, and two Paul's tubes are tied in. The spur is destroyed later.

of an aneurysm needle the mesenteric vessels are then ligatured on the proximal side as far as the character of the glands or size of the tumour indicate to be necessary, and they are clamped with compression forceps on the distal or bowel side. Upon cutting through the mesentery between the ligatures and the forceps the fold of bowel, usually about a foot in length, is completely loosened, and now hangs out of the abdomen. The cut in the mesentery is sutured with catgut, and the two portions of bowel for about four inches beyond where they are to be cut across are also lightly sutured to each other, so that they lie together like the barrels of a gun. This arrangement is carried out in order to render the subsequent clamping of the spur safe from risk of perforation. Next, two intestinal glass drainage-tubes are ligatured into the bowel, one above and the other below the growth, and the affected part is cut away. The exposed mucous membrane round the tubes is cleansed and dried. The abdominal wound is sutured, and the ends of the silk ligatures round the tubes are passed through the skin to fix the latter securely. Then the stumps of bowel are covered with xeroform powder, the distal tube is plugged with wool, and a thin rubber tube is attached

to the proximal to carry off fæcal matter. Done in this manner the operation is almost bloodless, and the shock inappreciable (*see* Figs. 173, 174A, and 174B).

" The tubes remain in for from five to ten days, and the wound takes from three to four weeks to clear up. Then a strong clamp of Dupuytren type is introduced and the long spur is clamped (*see* Fig. 174B). This requires two days, and the healing of the clamped edges will occupy a couple of weeks. Finally, the mucous membrane is separated from the skin, without opening the peritoneal cavity, and sutured with catgut ; whilst the skin is brought together with deep mattress sutures of silver wire, which must be retained for some time as leakage with secondary union is perhaps more frequent than primary union. Silver wire is much to be preferred to any other sub-

FIG. 174A. Paul's method of resection of carcinoma of the colon. The two stumps are drained, and also sewn together for four inches, so that no small intestine can come into the grip of the enterotome, when the spur is being destroyed.

stance for the deep skin sutures. I have had the operation completed in the infirmary in a month, but it is a mistake to rush the various stages, and I now always tell my patients it will take quite two months to complete the operation, and that it will be three months before they can expect to be fit for work again.

" It might be assumed that bowel excised by bringing out the ends and restored by clamping the spur and suturing the opening without detaching it from its surface connections would differ considerably from the normal and be subject to stricture. Yet this has never occurred in any of my cases, and I have not been called upon to do any further operation to improve the condition of the bowel. On the contrary, I once saw the bowel five years afterwards, when operating for another trouble, and in this patient I could not have told that it had ever been touched at all. The entire sigmoid had been removed for gangrenous

FIG. 174B.   Paul's clamp for destroying the spur.

volvulus, and the ends · brought out and clamped as described. On looking at the part, I found neither stricture nor adhesions, nor, indeed, anything to suggest that such an operation had been done. The patient was a young lady, 25 years of age. It may, I think, be safely assumed that no inconvenience will follow this operation when once the artificial anus has been satisfactorily closed."

(2) **Excision of the Cæcum and Ascending Colon with the Corresponding Lymphatic Area.** This extensive resection is usually the best for carcinoma anywhere in this part of the intestine, for not only is it more radical than any other method, but it is also easier and safer, the blood-

supply of the parts to be joined together can be more certainly preserved, and the sewing can be done outside the abdomen and therefore with greater ease and security and with less risk of infection. This method is also applicable to certain cases of tuberculosis or other non-malignant disease limited to this part of the intestine, especially when the ileo-colic group of glands are infected. Jamieson and Dobson[1] having found, from their careful research upon the lymphatics of this part, that an operation for carcinoma to be radical must remove all the ileo-colic group of lymphatic glands reaching as high as the duodenum, suggested such an operation in detail. In the operation the bowel well wide of the disease, the lymphatic vessels and primary lymphatic glands are removed *en masse*. Hitherto surgeons had been content to remove some of the lower ileo-colic glands, but F. S. Bird[2] had described an operation more radical than that usually adopted at that time. More than twenty years ago Mr. Lawson, of Hull,[3] mobilised the ascending colon after dividing the parietal peritoneum to the right of it, and removed the lower six inches of the ileum, cæcum, and greater part of the ascending colon together with some enlarged glands. The patient, aged 33, made a good recovery, and was well three months later.

Later Mr. Dobson[4] successfully performed the operation, and I venture to quote the excellent description of his first case :

" **Carcinoma of the Ascending Colon.** The patient, a man aged 47 years, was admitted into the Leeds General Infirmary on September 17, 1907, under the care of Dr. W. H. Maxwell Telling. The history given was as follows : He had enjoyed good health until a year ago, when he began to suffer from pain in the epigastrium. This pain was noticed from time to time, and in February 1907 he had a severe attack accompanied by vomiting ; at the same time the abdomen was said to be swollen and he was troubled with flatulence. He had had no vomiting since this attack in February ; there had been neither constipation nor diarrhœa, and no blood had been seen in the stools. He noticed a swelling in the abdomen in March and thought it had increased in size lately ; he lost weight considerably up to February, but not since. The patient was extremely anæmic ; the pulse was feeble. There was a mass in the right loin which could easily be felt on bimanual palpation ; it was hard and nodular, rather tender and slightly movable ; the abdomen was not distended and there was no visible peristalsis. There was no enlargement of the liver and no ascites. The urine contained organisms but no pus or albumin.

" **Operation.** This was performed on September 30, and the following description of it is taken from the notes written by Mr. L. R. Braithwaite, the resident surgical officer, who assisted. 'An incision seven inches long was made in the right linea semi-lunaris, the tumour in the ascending colon was defined, and the small intestine was packed off to the left side of the abdomen. The duodenum and the ileo-colic vessels were then defined, the overlying peritoneum was divided, and a fairly large uppermost gland of the ileo-colic chain was pushed downwards. The artery and vein were then clamped and divided, the ligature being applied about half an inch from the superior mesenteric artery. At this stage clamps were applied to the transverse colon close to the

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[1] *Lancet*, 1907, vol. i, p. 1142.   [2] *Lancet*, 1906, vol. i, p. 440.
[3] *Lancet*, 1893, vol. i, p. 618.   [4] *Lancet*, 1908, vol. i, p. 149.

hepatic flexure and to the ileum about six inches from the ileo-cæcal valve. The peritoneum on the outer side of the ascending colon was then divided and the whole mass, ascending colon, cæcum, and terminal portion of the ileum, was thrown over to the left, the peritoneum, ileo-colic vessels, and chain of glands being stripped up to the duodenum ; the ureter was seen and avoided and some vessels were tied. The meso-colon was then divided from the duodenum to the selected point on the colon, some branches of the middle colic artery being tied. In the same way the peritoneum of the anterior layer of the mesentery was divided down to the ileum and also the posterior layer, and the terminal branch of the mesenteric artery was secured. The whole mass was now easily withdrawn from the abdomen and the colon and ileum were divided between clamps ; both ends were closed by celluloid thread continuous suture, three layers in the colon and two in the ileum. Lateral anastomosis between the two portions of gut was now effected, thus drawing up the mesentery and covering in the denuded area on the posterior abdominal wall. A small tubular drain was inserted through a stab wound in the loin and the anterior wound was closed in the usual way.

" ' The patient made an excellent recovery from the operation ; there was some distension of the abdomen with vomiting on the second day, but this ceased after the bowels had acted. The tube gave exit to a certain amount of discharge and a small sinus remained which did not completely close for a few weeks. At the present time the patient is very well ; he has gained two stones in weight and his anæmia is much better.

" ' On examining the specimen, almost the whole of the ascending colon was found to be infiltrated with growth, in parts an inch thick. The mucous membrane over the growth was ulcerated. The hepatic flexure was not invaded. The ileum was slightly hypertrophied ; the cæcum was distended with thin fæcal material, and its walls were slightly thickened ; the ileo-colic opening was smaller than usual. The appendix was normal in appearance. The ileo-colic chain of glands lay close to the ascending colon ; many of its members were enlarged, the highest (duodenal) gland being the size of a bean. The right juxta-colic glands were enlarged and adherent to the growth. There was no infiltration of the parietal peritoneum on either side of the gut. On microscopical examination the growth was found to be a columnar-celled carcinoma. There was no evidence of disease in any of the glands of the main ileo-colic chain examined. One of the juxta-colic glands examined was found to be completely infiltrated with growth.' "

It is an advantage to elevate the right side of the body during this operation, so that the small intestine may cause less embarrassment. Sometimes it is difficult to bring the transverse colon and the ileum satisfactorily together ; then ileo-sigmoidostomy may be performed with greater ease and advantage.

A similar operation is often required for tuberculous disease limited to this part of the intestine. The following case, which was published in the Guy's Hospital Reports,[1] is an interesting example of this condition.

E. H., aged 30, a torpedo-fitter, was sent up by Dr. Kidd, of Blackheath, and was admitted into Guy's Hospital on August 11, 1910, under the care of Dr. Fawcett, and later of Dr. French. He complained of abdominal pain after meals. He had

[1] French, Rowlands and Poulton, *Guy's Hospital Reports*, vol. lxv, p. 265.

suffered from " influenza colds " since he was 20 years old. The cold usually came on in the winter-time. Two years ago he coughed up some blood, but tubercle bacilli were not discovered in the sputum on examination, and it was at this time that the attacks of abdominal pain began. They occurred intermittently, sometimes several weeks elapsing between the attacks. The pains were noticed about four or five hours after a meal, and the patient complained that they were most severe when the meal had been heavy, and had contained a lot of vegetables, of which he was very fond.

The pains were colicky in nature ; they lasted a short time each, and they were repeated. He stated that they started in the right iliac fossa, and spread from there over the abdomen. At the same time he frequently observed the formation of a lump in the right iliac fossa. The pains did not occur during starvation, and the patient used to find that he obtained relief on making himself sick. He had, however, spontaneously vomited on one occasion only. He had been inclined to constipation for the last two years, and he had been obliged to use medicine and enemata on this account.

He usually had a good appetite and enjoyed hearty meals, although he disliked their after-effects. He complained of being rather wasted, and stated that he could not put on flesh in spite of his healthy appetite. On several occasions the patient had been confined to bed with attacks of " appendicitis," a definite swelling in the right iliac fossa, and a raised temperature being noted. He was admitted at the end of such an attack.

On admission his weight was 8 st. 6 lb. He was an intelligent man who was able to give a very clear account of his illness. His pulse was 64 ; temperature 96·6° F. ; and respiration 24. His chest showed signs of phthisis at the right apex, where there was some impairment of note on percussion, especially noticeable at the apex of the right lower lobe, together with whispering pectoriloquy below the right clavicle. No râles were heard.

A skiagram showed a well-defined blotchy impairment at the apex of the right lower lobe, especially behind. The diaphragm moved poorly on both sides in front, but better when viewed from behind. Some rigidity was present on the right side of the abdomen, and a lump as big as a walnut could be felt in the right iliac fossa, and there was tenderness at this spot. A big meal containing plenty of vegetables was administered, and subsequently visible peristalsis was observed starting low down near the middle line and travelling into the right iliac fossa, and disappearing below and to the right of the umbilicus. A bismuth meal was given to the patient one day at 6 A.M., and the diagram shows the presence of the meal at the lower end of the ileum after nine hours. The bismuth was still present in the ileum in large amount after ten hours had elapsed. After thirty-two hours most of the bismuth was in the transverse colon, but some had already reached the rectum. On another occasion the bowel was cleared out and air was injected into the colon per anum. The X-rays showed that most of the air remained in the rectum (where the tube is seen doubled on itself). The air, however, penetrated as far as the hepatic flexure, and the whole of the large intestine can be seen transparent to the rays up to this point. The opacity at the right iliac fossa, however, shows that the air had not entered the cæcum.

On rectal examination something abnormal could be felt on the right side of the recto-vesical pouch. This was thought to be a diseased appendix.

Operation. When the patient was under the anæsthetic on the 19th, a swelling and peristalsis appeared in the right iliac region far inwards, and a distinct movable swelling was felt. The abdomen was opened by displacing inwards the lower part of the right rectus, the cæcum was felt to be enlarged, and the lower end of the ileum was greatly dilated and hypertrophied. The appendix was greatly distended and yellow, and intimately bound to the cæcum. The mass was brought out of the wound. There was a firm congested thickening at the lower end of the ileum as it entered into the cæcum. The peritoneal coat of the lower end of the ileum and cæcum was inflamed, and there were a good many minute tubercles to be seen upon it, but there were none upon other parts of the intestine. Many glands in the mesocolon were considerably enlarged. It was decided to remove the swelling in preference to doing an anastomosis between the ileum and the colon. Six inches of the ileum, the cæcum, and the ascending colon, together with the appendix and the enlarged glands in the mesocolon were removed *en masse*. The ends of the ileum and ascending colon were tied and inverted. Then a lateral anastomosis was made between the ileum three inches above the blinded extremity, and the first part of the transverse colon. The abdomen was completely closed in

layers. The operation lasted one hour and a half. The patient was not collapsed at the end of it, and he made an uninterrupted recovery. The bowels were opened naturally four days after the operation. On discharge from the hospital on September 13, his weight was 8 st. 8 lb. He has since gained a stone in weight and has remained well for three years. The specimen removed shows:

(i) *Macroscopically.* Ulceration and infiltration of the cæcum, the ileo-cæcal valve, and the lower end of the ileum, with thickening of the walls, and stenosis at or near the valve. The cæcum was greatly contracted in size. The ileum was greatly dilated and hypertrophied. Tubercles were evident on the peritoneum of the ileum. Contracting ulceration was observed for two and a half inches all round the bowel at the valve, and extending into the cæcum and ileum. The strictured opening of the appendix was in the floor of the ulcer at the point where the stenosis was greatest. The appendix was thickened, infiltrated with tuberculous disease, coiled, and very adherent to the cæcum. Its lumen was almost occluded in places.

(ii) *Microscopically.* Sections showed the presence of typical tuberculous giant cell systems in the wall of the bowel at the stricture and also in one of the enlarged lymphatic glands.

(3) **Excision of the Hepatic Flexure.** Growths at or near the hepatic flexure, unless quite early, are somewhat difficult to remove satisfactorily. The anatomical fixation of the bowel can be overcome by mobilisation as already described, but pathological adhesions are apt to cause more trouble, especially when the right portion of the transverse colon is short. Adhesions to the duodenum and pancreas are especially troublesome and may make it impossible to get well beyond the disease without grave injury to these vital structures. Therefore early recurrence is not uncommon.

The lymphatic drainage is chiefly along the course of the right division and trunk of the middle colic artery, so that in early cases it is necessary to remove the right half of the mesocolon and tie the right division of the mesocolic artery. Later cases may require the removal of the greater part of the transverse mesocolon with division of the mesocolic artery itself. Then the greater part of the transverse colon has to be removed, for its nutrition is entirely dependent on the left colic artery. In many cases such an extensive resection can be avoided by removing the glands and lymphatic vessels from the mesocolic arteries by gauze dissection after incision of the lower leaf of the mesocolon. After wide resections here, certain difficulties arise in restoring the channel, for in spite of mobilisation it is not easy to join the lower part of the ascending colon to the middle or left third of the transverse colon. To avoid tension axial union has to be adopted and the large area devoid of peritoneum, which is found on the posterior aspect of the ascending colon in 75 per cent. of the cases, makes it difficult to effect a satisfactory union.

Closing the two ends is not satisfactory, for with lateral ileo-colostomy, fæcal matter still enters the cæcum and may cause trouble at the closed end of the colon, especially if the ileo-cæcal valve is efficient. End-to-side ileo-colostomy is unsuitable, for this either leaves a closed pouch consisting of the end of the ileum, cæcum, and some of the ascending colon, or a portion of bowel requiring permanent drainage of mucous secretion. It is therefore clear that when extensive resection is necessary, it is better to remove the cæcum and ascending colon as already described, and then to join the mobile ileum about six to ten inches from its termination to the middle or left third of the transverse colon, or what is more suitable in some cases, to the pelvic colon. This plan has the additional merit of allowing a much freer removal of the

bowel above and below the disease, and of the ileo-colic glands, some of which may be infected. It is right to say, however, that early and local resections have been successful; thus Mr. Makins[1] has "one patient alive and well at the end of fifteen years, and one survived four years before a recurrence took place."

Operation. A long incision is made through the outer part of the right rectus. The edges of the wound are protected and well retracted. The right side is elevated and the small intestine is packed off towards the left. The transverse colon is drawn upwards and forwards while the right branches of the mesocolic vessels are doubly tied and divided half an inch below the main trunks through an incision on the under surface of the mesocolon. This incision is carried downwards and inwards towards the spine, and the lymphatic glands upon the mesocolic trunks are separated and brought forwards by gauze dissection. The ileo-colic and right colic arteries are similarly tied and divided through a transverse incision made near the lower border of the third part of the duodenum. The peritoneum reflected from the ascending colon to the flank is divided half an inch away from the bowel. Two fingers are introduced and the peritoneum is raised by these and divided as far as the outer border of the second part of the duodenum, where caution is required. By gauze dissection the ascending colon and lower part of the ileum are mobilised as already described, care being taken to save the ureter (*see* Fig. 175). The gastro-colic ligament is then divided to the required extent, and all bleeding points are tied. Adhesions between the growth and the flank, the gall-bladder or lower surface of the liver are carefully separated by gauze dissection. In some cases the gall-bladder may be so hopelessly adherent as to need removal with the growth. The incision in the parietal peritoneum already described is carefully prolonged inwards through the short right portion of the transverse mesocolon, and any adhesions between the growth and the duodenum or head of the pancreas are carefully separated (*see* Fig. 175). A shaving of the pancreas may be removed if necessary, and an invasion of the anterior wall of the duodenum may be resected, and the wound thus left immediately closed with continuous sutures and reinforced by any flap available from the root of the mesocolon. The separated intestine is brought outside the abdomen, and clamps are applied near the points selected for division, which are generally near the middle of the transverse colon, and six inches above the termination of the ileum (*see* Fig. 176). The incision on the under surface of the mesocolon is deepened and prolonged forwards to the site of division. The incision in the posterior peritoneum over the ileo-colic vessels is carried down to the ileum about six inches above the ileo-cæcal valve, and the anastomosis between the ileo-colic and inferior mesenteric vessels is tied. Packs are carefully placed behind the bowel and mesentery, and the ileum and colon are divided between the ligatures and clamps, and the growth is removed. The tied end of the colon is then inverted with two seromuscular purse-string sutures of fine linen thread. These sutures are placed about half and one inch away from the tied extremity. Then the next step is considered. If possible without tension, the ileum is brought up and an end-to-side anastomosis is made between it and the transverse colon. If this is impracticable, as it may be when much of the colon has had to be removed, the anastomosis is made

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[1] Burghard, vol. ii, p. 461.

between the ileum and the middle of the pelvic colon (*see* Figs. 177 and 178). Time is saved by closing only the open end of the colon and implanting the end of the ileum in the colon, and if the section of the ileum is somewhat more oblique a very satisfactory opening can be
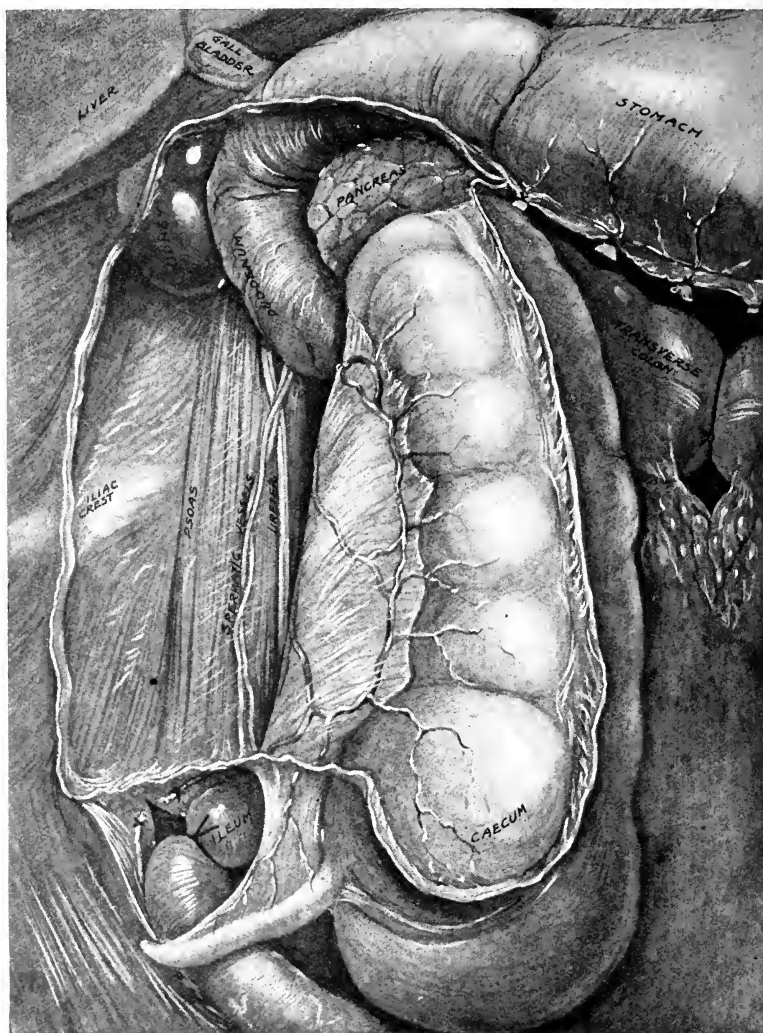
Fig. 175. Excision of the hepatic flexure for carcinoma. The cæcum, six inches of the ileum, and some of the transverse colon are generally removed at the same time to make the operation more radical and the anastomosis easier and safer. The colon is mobilised as shown in the figure and brought out of the wound before the ileum and transverse colon are divided.

obtained in this way. The writer in 1906 performed an extensive resection for carcinoma of the ascending colon and hepatic flexure in a man, aged 60. A short account of the operation was published in the last edition of this work.[1] The cæcum, ascending colon, hepatic

[1] Vol. ii, p. 392.
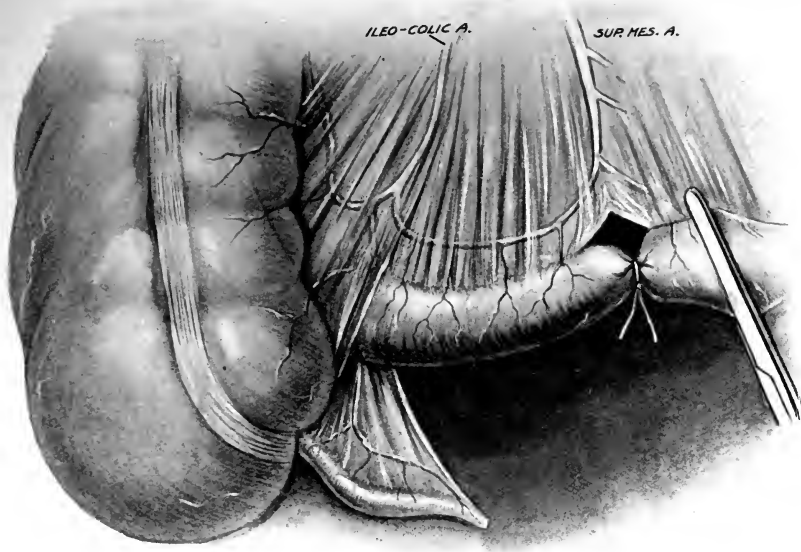
FIG. 176. Excision of cæcum. When the part to be removed has been brought outside the abdomen, the ileum is divided opposite the bifurcation of the inferior mesenteric artery. The distal end is tied but not invaginated.
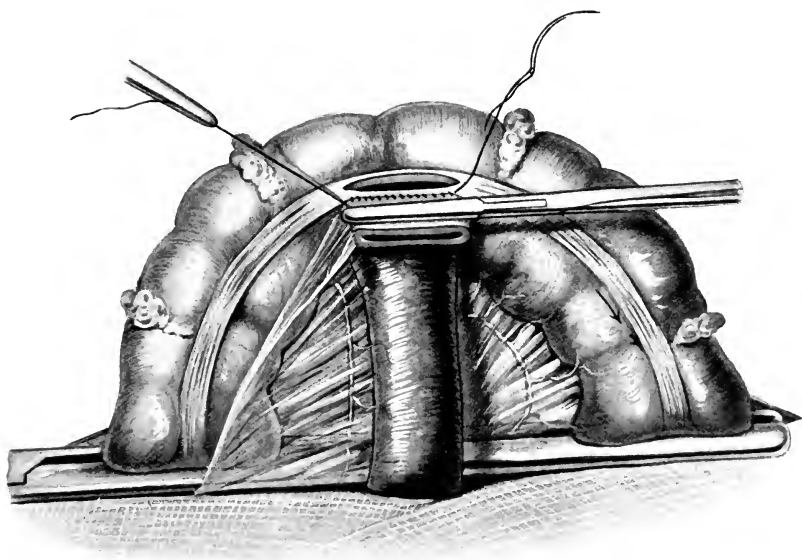
FIG. 177. End-to-side anastomosis of ileum to colon. The opening in the colon is shown too near the sero-muscular suture.

flexure and several inches of the transverse colon, together with most, if not all, of the ileo-colic glands were removed *en masse*. Too little of the ileum was removed, with the result that the axial union made by two layers of suture partly gave way and a fæcal fistula formed. This was closed later, but the man died of recurrence in the liver about a year later. Much difficulty was experienced in separating the growth and some enlarged glands from the duodenum and pancreas. At least six inches of the ileum should be removed in order to obtain for the
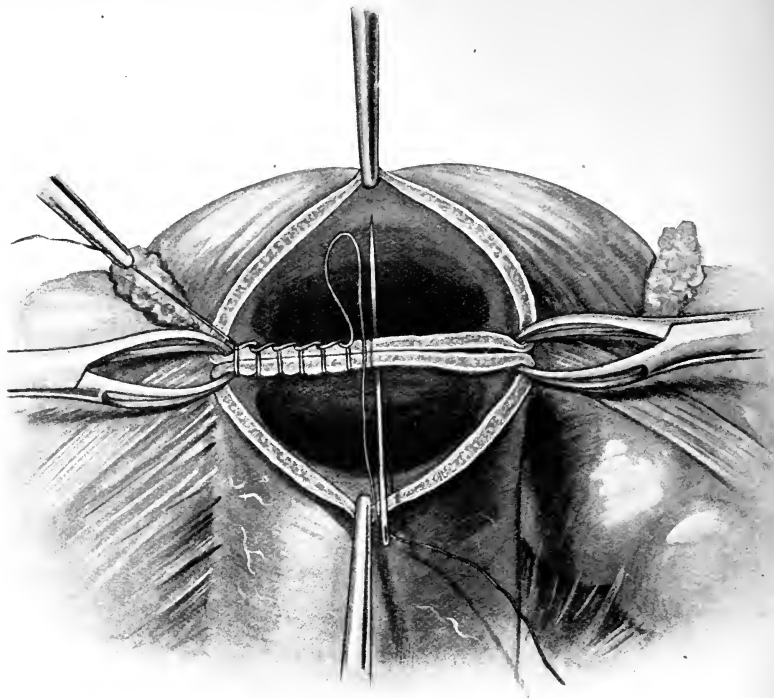
FIG. 178.   End-to-side anastomosis of ileum to colon.   The deep or button-hole
suture is shown.

anastomosis a more movable part with a longer mesentery and better blood-supply.

(4) **Excision of the Transverse Colon.** Growths of the transverse colon are felt early and are favourable for resection for (i) the presence of the mesocolon allows easy and comparatively safe axial union and (ii) the lymphatic glands of this part are not affected early and extensively. Moreover the omentum is available for protecting the line of suture. The growth, and three inches of bowel on either side of it, together with a corresponding wedge of mesentery and the paracolic and intermediate glands are removed, the main trunk and generally the right branch of the mesocolic artery being saved. In some cases only the arterial arch between the mesocolic and left colic arteries has to be divided.

(5) **Excision of the Splenic Flexure.** This may be very difficult, for this part of the colon is highly and deeply placed and tethered by the short costo-colic ligament. A growth here may become adherent to the

spleen, stomach, or kidney. Moreover some of its lymphatics drain into the splenic lymphatic glands. Late growths here and in the transverse colon may ulcerate into the stomach, causing distressing fæcal vomiting. It is difficult or impossible to feel an early growth here, and even when the distended abdomen is opened for intestinal obstruction, it is not easy to reach and feel a growth in this situation, but distension of the transverse colon is a stimulus to further search. The lymphatic drainage is along the left side of the mesocolon and the ascending branch of the left colic artery, and calls for the removal of about a third of the transverse colon and the upper four inches of the descending colon.

Operation. Access is best obtained through an oblique and long incision an inch below and parallel to the left costal margin, as suggested by Makins. The external peritoneal reflection of the descending colon is divided and the incision is carried upwards until the costo-colic ligament is divided. The colon is mobilised by gauze dissection and drawn inwards. The left part of the gastro-colic ligament is divided. There may be considerable difficulty in separating the growth from the spleen, stomach, or left kidney. When it has been freed, the growth is delivered and removed in much the same way as already described under removal of the hepatic flexure. The anastomosis may present further difficulties and call for further mobilisation as far as the pelvic colon. When this is carried out the transverse colon can be joined to the descending colon either by lateral anastomosis after closing the divided ends, or by end to end union. I prefer the latter method unless the transverse colon is dilated to a much larger size than the descending colon, or the latter has a large area uncovered by peritoneum. Makins found implantation of the descending colon into the side of the transverse colon unsatisfactory in two cases, secondary stenosis occurring. In some cases the cut ends should be closed and an anastomosis made between the middle of the transverse colon and the sigmoid. Growths of the descending colon are very rare, and are treated in a similar way, the main secret of success depending on free mobilisation of the bowel above and below, so that the cut ends can be easily approximated.

(6) **Excision of the Pelvic Colon.** Carcinoma is far more common here than anywhere else in the large bowel except the rectum, and in the majority of cases it is of the small annular variety. Clogg, in eighteen autopsies, found enlarged glands in eighteen, but these were in close proximity to the growth in all except six, and in three of these there were enlarged glands on the inferior mesenteric trunk or even higher. In only two-thirds of the cases were cancer cells found in the enlarged glands. These facts, and the long mesentery almost invariably present, make growths of this part unusually favourable for removal. Even limited resection of the growth, small lengths of bowel above and below with a small portion of the mesocolon, have been attended with good results, but there is little doubt that wider resections are likely to improve the results. Clogg believes " that in cases where the cancer is in that part of the bowel supplied by the sigmoid artery, a resection of this loop with the contained mesentery to the origin of the vessel will be the most satisfactory method of dealing with it." Jamieson and Dobson,[1] Moynihan,[2] and Kummel[3] advocate wider resections with more extensive removal of the " lymphatic area."

[1] *Loc. cit.*   [2] *Surg. Gynæcology and Obstetrics*, May 1908.
[3] *Arch. f. Klin. Chir.*, 1899, vol. lix, p. 555.

It is most important to realise that when necessary very extensive resections can be rapidly and successfully carried out after the descending, iliac and pelvic colons, and the splenic flexure have been freely mobilised. Also that, if necessary, the inferior mesenteric artery may be tied and divided a little below the left colic artery without seriously interfering with the nutrition of the colon as low as the middle of the loop of the pelvic colon, the circulation being carried on through the anastomotic arches between the left colic and the sigmoid arteries. As a rule, however, the best place to tie the inferior mesenteric artery is a little above the origin of the lower sigmoid artery. This fact is especially important to bear in mind when removing a growth of the lower part of the pelvic colon, for without this precaution an ill-nourished or dead lower end may be left for the anastomosis.

Operation. The surgeon stands on the left of the patient, and makes a long incision an inch to the left of the middle line and extending from a little above the umbilicus to the pubis. The rectus fibres are separated and the peritoneum is opened sufficiently to admit the hand, which, after feeling the growth, is immediately passed upwards to examine the upper and lower surfaces of both lobes of the liver. Nodules of growth felt here indicate that resection must be abandoned. The lumbar glands are palpated and the pelvic peritoneum is examined, and if no growths or extensive adhesions are felt the resection is commenced.

The Trendelenberg position is adopted, the peritoneal incision is enlarged and the edges of the wound are protected with large enveloping pads of gauze, which are maintained in position by the blades of suitable self-retaining retractors. The small intestines and cæcum are packed off with large and long moist gauze rolls secured at the outer ends. The glands along the inferior mesenteric artery are examined, and an incision is made through the parietal peritoneum about an inch to the left of the descending colon, and this incision is carried both upwards and downwards, to the extent required for the free mobilisation of the colon, care being taken to avoid injuring the spermatic vessels. These and the ureter are left behind, but sometimes the blood-vessels are inseparable from the growth and have to be removed with it. The ureter, being much further in, is rarely adherent (*see* Fig. 175). The colon is rapidly mobilised by gauze dissection and without appreciable loss of blood. The blood-vessels are now examined and an incision is made through the mesial leaf of the mesocolon over the inferior mesenteric artery below the origin of the left colic artery. This is continued downwards and to the left towards the sigmoid loop, and the glands with the loose connective tissue bearing lymphatic vessels are separated from the artery from above downwards by gauze dissection. If it becomes evident as the dissection is progressing that the growth cannot be satisfactorily removed without dividing the inferior mesenteric artery and vein, these are tied and divided at least an inch below the left colic artery and, if possible below the upper sigmoid artery, but above the lower sigmoid artery. In most cases it is not necessary to divide the inferior mesenteric trunks, and only the sigmoid vessels need division near their origin. Sometimes only one of these and some of the branches of the other have to be divided. The sites for section are now selected at least three inches above and two inches below the growth, and clamps and ligatures are applied above and below each of these points (*see* Fig. 179). The mesentery is divided to the required extent, the loop is brought

outside the abdomen, and moist gauze packs are placed behind and around it. The intestine is then divided between the clamps and the ligatures and removed. The remaining ends should project about an inch beyond the clamps. They are cleaned with gauze swabs moistened with methylated spirit. If the bowel has been sufficiently mobilised
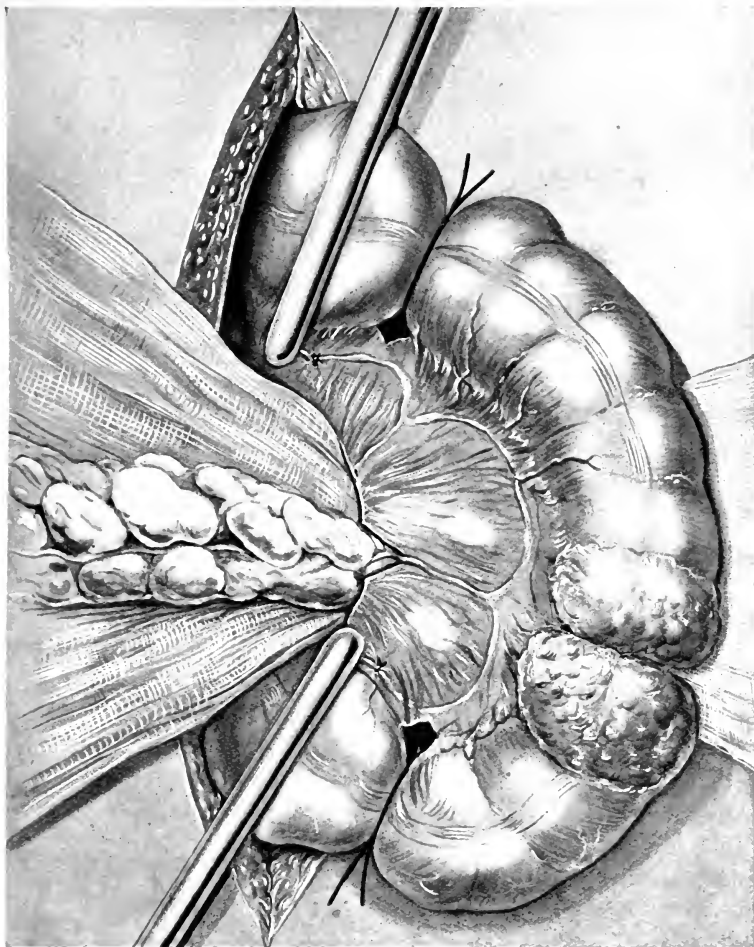
FIG. 179. Excision of carcinoma of the pelvic or sigmoid colon. The glands are cleared off the inferior mesenteric vessels, and brought out with the primary growth.

the ends can be brought together with ease and they are joined with two continuous sutures of fine linen thread as already described under End-to-End Union (*see* Fig. 180). Especial care is required to obliterate the mesenteric gap, and some of the appendices epiploicæ may be tacked over the line of union. When the clamps are removed a little bleeding may occur from the mesenteric arches close to the bowel. These points are tied, and the mesenteric incision is closed with a continuous catgut suture. The bowel is wiped with moist swabs

and replaced in the abdomen after all packs have been removed. The Trendelenberg position is abandoned, and the abdomen is closed in layers in the usual way. Drainage is rarely necessary, and tends to interfere with perfect union. If any contamination of the retro-peritoneal cellular tissues has unfortunately been allowed to occur, or persistent oozing takes place from inflamed surfaces, a tube may be introduced through a stab wound in the loin, and left for forty-eight hours. The following example is interesting and remarkable in several ways :

Dr. M., aged 48, is one of nineteen children. His father and one brother died of cancer of the bowel. He himself had suffered for years from piles from which
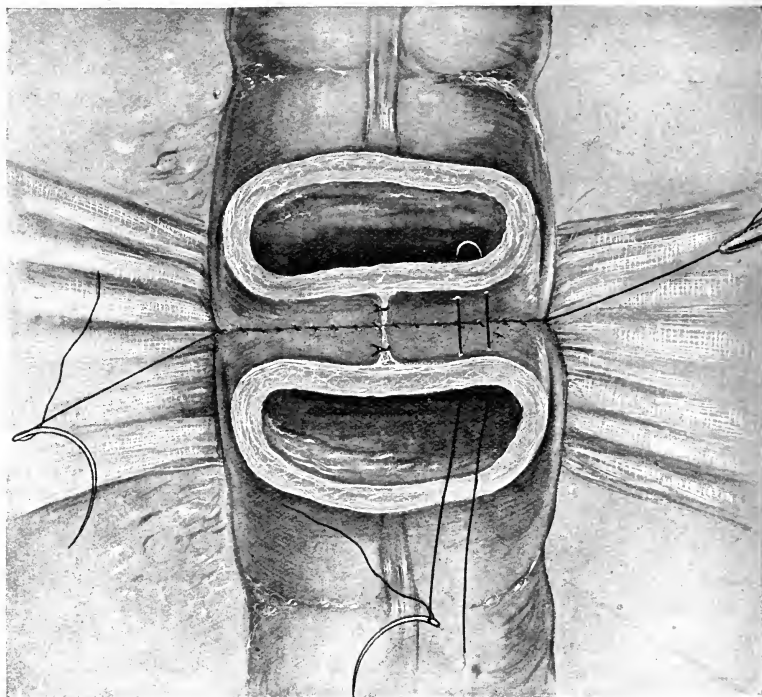
Fig. 180. Excision of carcinoma of the pelvic colon. The mesenteric space is obliterated with peritoneal flaps and sutures and end-to-end union is made with two continuous sutures.

bleeding had often occurred. For the last two years there has been a good deal more bleeding from the bowel, and this has been often associated with pain in the left iliac region. In March 1910, the bleeding became more severe and came on quite apart from defæcation. He gradually got into poor health and wasted a good deal, and a fortnight ago he fainted. Mucus and much blood escaped from the rectum. The patient saw several consultants and was referred to me for operation on October 19, 1910.

I felt an elevated growth high in the rectum. I could not find any stricture, but only what appeared to be an ulcer occupying one side of the bowel. During the examination the growth receded out of reach, clearly showing that it was fairly high in the bowel, but had intussuscepted into reach. Then the receded growth could be felt through the anterior wall of the rectum. It was thought that an abdomino-anal resection would be the best operation.

The bowels were well cleared out and the patient was kept at rest for three days and carefully prepared on a diet leaving little residue. Morphine grain ⅓ and

atropine grain $\frac{1}{150}$ were injected an hour before the operation on October 22, 1910, and axillary saline infusion was also commenced and continued during the operation, five pints in all being given. Open ether was administered by Mr. Plumtre. The abdomen was opened through the lower and inner part of the left rectus, and the growth was at once found in the lower part of the sigmoid loop about nine inches from the anus. It was freely movable, and some enlarged glands were felt in the meso-sigmoid. The liver and lumbar glands were normal. The high Trendelenberg position was adopted, and it was decided to resect the growth abdominally and join up the colon end to end. This was carried out as described above, nine inches of bowel and the lymphatic area being removed. Microscopic examination of the enlarged glands showed inflammatory changes only. End-to-end union was performed with two silk sutures. The first was a continuous Connell, and the second a continuous Lembert suture. The packs were removed and the rent in the mesentery was closed as far as possible with catgut sutures, and the bowel was replaced. The peritoneum was cleansed of blood, and the wound was completely closed in layers. The operation lasted an hour and a quarter, and at the end of it the patient was not collapsed. On opening the piece of bowel removed it contained no fæcal matter, only a little blood-stained mucus. An ulcer two inches long and one and a half inches wide with rampart-like edges was seen. The mucous membrane around the ulcer was much congested and inflamed. The ulcer did not encircle the bowel or appreciably narrow the lumen ; it had clearly obstructed and caused pain only by intussusception. There were very few enlarged glands in the mesentery, except quite close to the growth, which was a columnar-celled carcinoma.

The patient did very well, the wound healed without any trouble, and he left the home within a month. He was at work in his busy practice within two months of the operation. He was quite well four years later.

Case II. Another patient, a man aged 68, with a massive adherent growth of the first part of the pelvic colon, bore wide resection well, and in spite of a complicating enlargement of the prostate was able to leave London for his home three weeks after the operation, which was performed in November 1912. He was well in August 1913, but died probably of dissemination about six months later.

A similar operation is usually the best treatment for chronic inflammatory affections of the colon causing chronic obstruction. Tumour-like masses may form as a result of inflammation of diverticula of the colon. This disease may affect any part of the bowel, but it is common only in the sigmoid and descending colon. The writer published a paper upon this subject in the *Lancet*,[1] with a discussion of the diagnosis, pathology, and treatment. The following is one of the cases published in this article :

A stout man, aged 49 years, was referred to me by Dr. W. Hale White and Dr. C. J. Woollett in the middle of September 1909. Dr. Woollett gave the following excellent history :

" I have known Dr. —— for about five years, during which time I have occasionally attended him for laryngitis (simple) and for shingles ; his general health was good, and he weighed about sixteen stones. This spring Dr. —— consulted me about a pain from which he sometimes suffered on the left side of the abdomen. The pain was not constant and, as a rule, not severe. He stated that he had had it, on and off, for the last thirty years, and that, when he was a student, a German doctor told him that he was suffering from enlargement of his colon. Dr. —— told me that he suffered habitually from constipation, to overcome which he was in the habit of taking purgative pills, and consequently had two or three actions of the bowels per diem ; he did not pass blood. As a rule he had a good appetite, was a quick eater, and of a very energetic temperament. On inspection and palpation of the abdomen, and on rectal examination, I could detect nothing in the shape of a tumour. Deep pressure over the sigmoid caused some pain. The abdominal walls were then rather fat. At the beginning of September I was again called to see my patient. He had lost about two stones since my last attendance and had suffered frequently from his abdominal pain. At this date he complained of the

[1] *Lancet*, 1910, vol. i, p. 1194.

pain being more acute, and he had had rigors on the previous day. I do not think that he had vomited. On examination there was a temperature of about 102°, a quick pulse, furred tongue, and excessive tenderness on pressure over the sigmoid. The treatment consisted of hot fomentations and a febrifuge medicine and enemata. After a few days the temperature became normal, and the tenderness subsided, and then for the first time I discovered a tumour in the sigmoid region. I advised my patient to see Dr. Hale White who sent him to you."

Upon examination Dr. —— looked sallow, wasted, and flabby, but not thin. The abdomen was very flabby and had clearly wasted a good deal. In the left iliac fossa a rounded movable swelling of about the size of a cricket-ball could be felt. It moved more freely from side to side than vertically. He suffered much from flatulence, indigestion, and insomnia. His worst symptom was very severe tenesmus, which made him pay frequent visits to the lavatory, where he sometimes stayed for an hour at a time without getting much relief, only passing mucus and flatus. The pain extended up along the colon as far as the ribs on the left side. Upon rectal and bimanual examination no tumour could be discovered in the pelvis or bowel. The diagnosis was somewhat uncertain, especially on account of the unusually long duration of the symptoms of obstruction and the history of rigors, but an exploration seemed to be imperative. A growth of the sigmoid colon with inflammatory changes around it was considered to be the most probable diagnosis, but in view of the long history Dr. Hale White suggested that the disease might be non-malignant. The bowels having been cleared out as well as possible by means of castor-oil, ether was administered by the open method by Mr. W. H. Trethowan. The abdomen was opened through the lower part of the left rectus, and a tumour, thought to be malignant, was discovered near the middle of the sigmoid colon and its mesentery. The lumen of the bowel was considerably narrowed, but the bulk of the swelling was towards the mesentery, which was much shortened and very thick. Nodules, thought to be enlarged glands, also extended upwards along the inferior mesenteric vessels for several inches. Resection was decided upon, although the condition did not appear to be a very hopeful one because of the extensive infection of the lymphatic glands. The Trendelenberg position was adopted, and the small intestines were displaced upwards and to the right and carefully packed off with gauze pads. An incision was made along the parietal peritoneum to the left of the root of the mesocolon, and extending upwards nearly as far as the splenic flexure. By gauze dissection the sigmoid and its mesentery were separated from the iliac fossa and turned inwards. The ureter, which was attached to the mass, was carefully separated off and displaced backwards and inwards out of the way. When the bowel had been sufficiently freed it was turned back to the left, and the peritoneum covering the inferior mesenteric vessels was carefully incised close to the spine. The lymphatic vessels and glands were separated from the blood-vessels by gauze dissection from above downwards. The splenic flexure was mobilised after the manner recommended by Moynihan. The bowel and the mesentery were then clamped and the diseased parts were isolated and removed, care being taken to preserve the continuity of the superior hæmorrhoidal vessels. The mesentery was tied and the rent in it was sewn up. An end-to-end union was made by direct suture, the first layer passing through all the coats, the second including only the sero-muscular tissue. A small temporary drain was placed at the lower angle of the wound, which was elsewhere closed in layers in the usual way. To ensure absolute rest to the bowel very little but water was given by the mouth for three days, and morphine was injected subcutaneously to procure sleep on the first and second nights. No purgative was given by the mouth and the bowels were allowed to open naturally with the aid of a small oil enema on the eighth day. The patient made a good recovery and left the private home a month after the operation. He has remained well and has been in active work for five years.

Specimen. Six and a half inches of bowel were removed. Upon slitting it open along its free border no growth was seen. Something bulged in at the mesenteric border. The mucous membrane was neither thickened nor ulcerated. Upon cleaving the mesentery many necrotic foci were seen, and several of these had broken down into small abscesses. A probe could be passed into several pouches, extending into the mesentery from the mesenteric border of the bowel, and reaching quite near to some of the breaking-down areas. The necks of the pouches were quite narrow, so that they would be overlooked unless specially sought. None of the diverticula was visible on account of the thickness of the fat mesocolon. A piece of the diseased mesentery was sent to the Clinical

Research Association for microscopic examination. The following report was returned :

"This specimen is composed of fat and fibrous tissue with occasional nerve fibres. It is inflamed and shows marked leucocytic infiltration and endothelial proliferation, with a phagocytic giant cell here and there. We find no evidence of tubercle or of malignant growth."

Results of Colectomy. Colectomy is a formidable operation and is usually called for in elderly patients who are exhausted by chronic intestinal obstruction. The immediate mortality therefore is high and is likely to remain considerable in spite of improvements of technic. In no large series is the mortality under 20 per cent. The ultimate results, however, are much more satisfactory, and are likely to improve with earlier and more radical operation.

Mr. Paul [1] says : "I have undertaken colectomy on eighteen private patients during the last ten years. Only one died—the patient in which I foolishly attempted primary suture, an otherwise favourable case of malignant growth in the transverse colon. The remaining seventeen were done by the glass tube operation, and all recovered, though some of them were advanced in years. Among the most interesting points noted in the Table is the long survival of patients who have been operated on for cancerous growths. Of the seventeen cases three were non-malignant and fourteen cancer. Of the latter eight are still living and not known to have recurrence ; two have died from apoplexy ; and four have died from recurrence at two and a half, three and a half, three and a half, and seven years respectively. It would be difficult to find another group of cancer cases showing such a satisfactory result. I certainly could not match it in any other branch of my work. Beyond the ten years I know of several cases living and well, but thought it undesirable to complicate the matter by reference to patients outside the period selected."

"Summary of colectomy cases. All cases operated on in private practice, 1901 to 1911 : 18 cases, 6 males, 12 females.
Mortality. 1 death (primary suture), 17 recoveries (glass tube operation).
Situation. Cæcum, 7 ; sigmoid, 8 (3 volvulus) ; colon, 3.
Age. 20–30 (2), 30–40 (2), 50–60 (8), 60–70 (5), 70–80 (1).
Life after operation—non-malignant : all living, 3, 9, and 10 years. Malignant :
8 living, $\frac{1}{2}$, $1\frac{1}{4}$, $2\frac{1}{4}$, 3, $3\frac{1}{4}$, 6, $7\frac{1}{4}$, $7\frac{1}{4}$ years ; died, recurrence, $2\frac{1}{2}$, $3\frac{1}{4}$, $3\frac{1}{2}$, 7 years ; died, apoplexy, $\frac{1}{4}$, $2\frac{1}{2}$ years."

Mr. Bilton Pollard [2] records seven cases of excision of carcinomatous growth of the colon ; all these patients survived the operations, and one was alive and well four years afterwards, another after two and a half, and a third after two years and two months. One died of heart disease after four years. The others were recent cases operated upon nine, six, and two months before publication. End-to-end union was made by direct suture, two rows of stitches being used. The parietal wound was drained in only one case—one in which a portion of the kidney was excised due to invasion of growth. Mr. Pollard's patients were well a year after his paper was written, and he had performed two more colectomies successfully during the year.

Mr. Littlewood [3] publishes fourteen cases of resection of the colon for columnar-celled carcinoma with ten recoveries. End-to-end union

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[1] *Loc. cit.* [2] *Lancet*, 1904, vol. i, p. 175.
[3] *Lancet*, May 30, 1903.

was made by means of Czerny-Lembert sutures of catgut in all except one, in which lateral anastomosis was used instead, because the ends could not be brought together, the ileum was joined to the sigmoid colon ; death occurred six days later. " Of the six successful cases of primary colectomy, there was practically no obstruction at the time of the operation." In one case there was obstruction, but the condition of the intestine seemed to be so good that an immediate resection was undertaken, but the stitches tore out and death occurred from peritonitis on the sixth day. This case illustrates the danger of primary resection and suture in cases of obstruction.

Complete colectomy will be described under Chronic Intestinal Stasis, chapter xxi.

CHAPTER XX

ACUTE INTESTINAL OBSTRUCTION

THE grave urgency of this condition is not yet sufficiently recognised ; our chief hope of lessening its appalling mortality is in earlier diagnosis followed by immediate operation. Therefore I think it vital to discuss the diagnosis here.

Symptoms and Signs. (*a*) *Pain.* The initial pain of acute intestinal obstruction is usually severe, especially about the umbilicus. When the obstruction is in the small intestine there is often great pain in the back. Later the abdominal pain is of a colicky nature, and it is often accompanied by visible peristalsis, and followed by vomiting.

(*b*) *Collapse.* The patient remains somewhat collapsed throughout, his face being pale and often leaden and pinched. The temperature is subnormal in the early and important stages, but towards the end it may be raised from septic infection.

(*c*) *Vomiting.* The vomiting due to obstruction, especially of the small intestine, is persistent and intractable. It is only temporarily relieved by starvation or even by washing out the stomach. The vomit gradually becomes brown and offensive, and later fæcal.

(*d*) *Constipation.* The constipation is absolute, both for fæces and flatus. This statement needs a certain amount of qualification. Large enemata may bring away a good deal of fæces from the bowel below the obstruction, especially if the obstruction is high up in the small intestine. Again, the bowels may act fairly well, or there may even be diarrhœa with Richter's variety of strangulated hernia, in which the bowel may not be completely obstructed.

(*e*) *Peristalsis.* This, when seen, is of great importance, but it may not be visible with very acute obstruction high up in the small intestine, especially if the abdominal wall is very thick. Very late in obstruction it may cease. Normal peristalsis may be seen through a very thin abdominal wall.

(*f*) *Quickening Pulse.* Although at first the pulse is slow and weak, later it invariably becomes quick and feeble. A quickening pulse is of the gravest significance. It must not be forgotten that all the symptoms may be minimised by starvation or masked by the administration of sedatives, especially morphia. There is often a misleading lull due to natural exhaustion. Very soon, however, the symptoms return in an aggravated form, and rapidly lead to a fatal result.

(*g*) *Thirst.* The thirst that usually accompanies intestinal obstruction, especially of the small intestine, is very severe.

(*h*) *Insomnia.* The subject of intestinal obstruction hardly sleeps at all until the obstruction is relieved, unless morphia is given. The administration of morphia *for abdominal pain of uncertain origin* is to

be most strongly condemned, for it masks nearly all the symptoms, and therefore delays diagnosis and treatment.

▶ (i) *Distension.* Gradually the abdomen becomes more distended, yet supple, and moving on respiration.

Of all the symptoms complete constipation is the most important. As a rule, the patient has already taken a purgative before calling his doctor. It is not wise to give repeated purgatives, which, failing to act, increase vomiting and collapse, and considerably reduce the chances of recovery of the bowel after operation. One of the worst purgatives to repeat is calomel, which may become a powerful irritant poison. I have known the repeated administration of calomel, in small doses, lead to ulcerative colitis. Repeated large enemata are much safer, and they give all the information that we require. When the diagnosis is made, or even strongly suspected, the patient's best chance lies in an operation performed at the earliest possible moment. Nowhere is delay more disastrous.

Diagnosis. We have first to diagnose intestinal obstruction from other diseases which simulate it, and then, if time permits, we may attempt to ascertain the variety and situation of the obstruction.

Briefly the symptoms are pain, collapse, vomiting.

(1) **Diagnosis of Intestinal Obstruction from other Diseases.** The essential thing in diagnosis is to decide quickly, yet carefully, whether the symptoms are such as to make an early exploration necessary or not. A careful study of the history, signs, and symptoms will generally lead to a correct conclusion, but sometimes there are many difficulties. All inflammatory diseases of the abdomen are distinguished by fever, although the temperature may be subnormal soon after the perforation of a viscus, or the rupture of an abscess into the peritoneum. Rigidity and tenderness of the abdomen, either local or diffuse, are important indications of local or diffuse peritonitis. Acute hæmorrhagic pancreatitis is often mistaken for intestinal obstruction. The patient, who is often stout and past middle age, is groaning with pain and is of a leaden colour. Pain and tenderness are said to have started, and they often remain worse, in the epigastrium. Sometimes there is a distinct fulness there. Fatty stools result from repeated large enemata, showing that true intestinal obstruction is not present. Moreover, the temperature is often raised, and the patient cyanosed. Constipation is rarely complete. Ruptured tubal gestation is characterised by the increasing pallor, the more rapid quickening of the pulse rate, and the peculiar doughiness of the distending abdomen. The history and examination of the uterus and breasts are often valuable. The best treatment for these conditions is immediate operation, therefore difficulty in deciding between them and intestinal obstruction is no excuse for delaying exploration. Acute gastritis may sometimes give rise to difficulties, but the vomit is not intestinal and constipation is not complete. The general symptoms are not so severe as those of intestinal obstruction. The various colics may give rise to difficulties, but with them, although the temperature is often subnormal, constipation is not complete, nor is the vomit brown and offensive. A purgative or an enema may act and flatus is often passed. With biliary colic there may be jaundice, or a history of previous attacks. Usually biliary colic is due to the impaction of a stone in the cystic duct ; then there are tenderness, rigidity, and often a swelling in the right hypochondrium, and later a raised tempera-

ture. With renal colic the pain is limited to one flank along the course of the ureter; there may be blood corpuscles in the urine, with frequency of micturition, and cystoscopy, after the intramuscular injection of indigocarmine, shows no coloured urine issuing from one ureter. The blue line of lead poisoning may suggest the cause of colic. It must not be forgotten, however, that the presence of a lead line does not exclude more serious disease. I remember two cases in which the discovery of a lead line led to disastrous delay in opening the abdomen. In one case a perforated duodenal ulcer was temporarily overlooked, and, in the other, obstruction by bands. In both of these the delayed operation failed to save life. Lead colic is rarely severe enough to keep the patient awake all night, nor is it associated with persistent vomiting. Moreover, repeated enemata are effectual.

When face to face with the possibility of intestinal obstruction it is most important to come to a decision without delay. The most important thing to do is to try the effect of large enemata. If these fail to do more than bring away a few scybala from the colon, intestinal obstruction may be safely diagnosed. Another vital thing is to examine all the vomit. Directly this becomes offensive or brown it is clear that intestinal obstruction is present. Washing out the stomach does not prevent this vomiting, for the contents of the obstructed intestine go on regurgitating into the stomach. Sometimes the vomiting ceases when all food is withheld. Therefore it is often wise to try the effect of food in order to accelerate the diagnosis. It also abates as the colic becomes less frequent and less powerful. Therefore when the stomach is getting distended with brown material the patient is only able to bring up mouthfuls at a time. On passing the stomach tube then one has been astounded to find several pints in the stomach. Another very important thing is to watch the patient carefully when the abdomen is exposed. Within half an hour colic comes on and the patient becomes paler, his face drawn and his abdomen rigid, and then peristalsis can be seen, and this is usually followed by vomiting. It cannot be too strongly urged that a weak and slow pulse and subnormal temperature are strongly suggestive of intestinal obstruction, especially when the other colics can be excluded. When the pulse quickens the patient is rapidly getting worse.

(2) **Diagnosis of the Variety of Intestinal Obstruction.** I shall begin with a classification which I find to be useful, for want of thought is a more common source of error than want of knowledge. How often do we have to admit that " we never thought of that " ? In many cases, if time permits, it is possible to arrive at a fairly accurate diagnosis of the nature of the obstruction before the abdomen is opened. This is sometimes of great value, for it enables us to consider the various steps of the operation and to anticipate some of the difficulties that we may encounter. In this way the duration of the operation may be diminished, and it is certain that in this condition quickness is more important than anything except judicious and careful work. Roughly the causes of obstruction may be divided into :

(1) Pressure on the bowel from outside.
(2) Disease of the wall of the bowel.
(3) Foreign bodies in the bowel.

This rough classification may be amplified, as follows :

(1) *Pressure on the bowel.*
(*a*) External hernia.

(b) Bands and adhesions following appendicitis, tuberculous peritonitis, pelvic peritonitis (especially due to tubal disease), sigmoiditis in which the appendices epiploicæ may form bands, diverticulitis, Meckel's, gastric or duodenal perforation, and operation.

(c) Internal hernia through a foramen in the omentum, mesentery, or diaphragm, into the duodenal or retro-cæcal fossæ or into the foramen of Winslow.

(d) Contraction of the mesentery from tuberculous or malignant disease.

(2) *Disease of the wall of the bowel.*

(a) Intussusception.

(b) Volvulus.

(c) Kink.

(d) Stricture, malignant and simple, tuberculous, after operation, after strangulated hernia.

(e) Paralysis of the bowel, especially after peritonitis ; or due to thrombosis or embolism of the mesenteric vessels.

(3) *Foreign bodies inside the bowel.*

(a) Gall-stones.

(b) Enteroliths.

(c) Actual foreign bodies, mostly in lunatics.

As a general rule obstructions of the small intestine are acute, whereas those of the large are chronic ; but there are important exceptions. For instance, strictures of the small intestine (which are rarely malignant) give rise to chronic terminating in acute obstruction. Again, volvulus of the sigmoid colon gives rise to very acute symptoms, and intussusception, which mostly affects the ileo-cæcal region, nearly always gives rise to acute obstruction. A strangulated hernia is placed first on the list because it is so often overlooked.

Considered generally, without reference to the causation of the obstruction, the successful treatment of acute intestinal obstruction depends largely on two points : (a) **The Question of Operation,** and (b) **The Question of the Extent of Interference that is indicated in any given Case.**

(a) **The Question of Operation.** Although cases of so-called " spontaneous cure " have from time to time been recorded, the number of these is so small, and the correctness of the diagnosis in many of them so doubtful, that for all practical purposes it is wiser to leave them entirely out of consideration. For, apart from these and the small number of cases of intussuscepton that have survived the sloughing of the intussusceptum, as Sir F. Treves says, " there is no avoiding the fact that acute intestinal obstruction, if unrelieved, ends in death." This being so, it clearly becomes the duty of the surgeon to operate on every case of acute intestinal obstruction. The operation, moreover, should be performed at the earliest possible moment after the diagnosis has been made, for, serious as the operation is in itself, it is not nearly so serious as delay, since the mortality rises extremely rapidly as the period between the onset of the symptoms and the time of operation increases. Neither should uncertainty of diagnosis be allowed to delay the operation, for of the many conditions that simulate acute intestinal obstruction—*e.g.* appendicitis, peritonitis from different causes, thrombosis of mesenteric veins, acute pancreatitis, enteritis, &c.—in some an operation may be beneficial, while as to the others it would be better

that an exploratory operation, as long as it is done by skilled hands, took place needlessly than that a remediable condition should be left untouched. Here, again, the valuable opinion of Sir F. Treves may be quoted. He says : " Operation in these cases is too often regarded as a *last* resource. It should be the *first* resource, as it certainly is the *only* resource."

The mortality of all cases of acute intestinal obstruction, as shown by Gibson [1] in a collection of cases operated upon between 1888 and 1898, was about 47 per cent., his list including 646 cases with 312 deaths. During the twenty years ended December 1907, of 400 consecutive operations at St. Thomas's Hospital [2] for obstruction from simple causes, excluding external hernia, 56·7 per cent. died. Of 143 operations for obstruction due to malignant disease 64·3 per cent. died. The mortality during the last five years of the period mentioned was somewhat less, being 45 per cent. for simple and 60·7 per cent. for malignant cases. Although this is without doubt a vast improvement upon former times, it is still to be hoped that in the near future earlier recognition and more immediate operation will do much to bring about still further improvement. Even then the mortality will probably be always high, and this owing to the frequently complicated nature of the cause of the obstruction, the peculiar vitality of the parts which are damaged, and the readiness with which these pass into a condition beyond recovery. The patient is often collapsed from irritation of the abdominal sympathetic, from want of fluid and from the absorption of poisons from the decomposing contents of the intestine. Hence the great importance of recognising that free drainage of the intestine is essential in late cases. Bearing in mind, however, the essentially fatal character of the condition, apart from relief by operation, every successful operation should be looked upon rather as a life saved, than every fatal one as a life lost.

(*b*) **The Extent of Interference that is indicated in a given Case.** The operation must be according to the state of the patient. These cases of acute intestinal obstruction are not to be grouped together as all equally fit for operation, or as all certain to be relieved by operation as long as this is undertaken early. In some the condition of the patient is good, the abdomen is undistended and a prolonged search may be made. In others a precisely opposite condition is present, any prolonged exploration is out of the question, and all that can be done, if the cause is not found at once, is to open one of the most distended coils, as low down as possible, and drain the intestines (*vide infra*).

Preparation for the Operation. While the operating room and instruments are being got ready the patient is carefully prepared in his own room. The bladder is emptied and the abdominal wall shaved and painted with iodine. An injection of a quarter grain of morphia, one-hundredth grain of atropine sulphate, and one-hundredth grain of scopolamine is given if possible three-quarters of an hour before the operation. The injection of these drugs has the great advantage of reducing the amount of anæsthetic required, for these patients stand anæsthetics badly. In nearly every case the stomach should be washed out when the patient is getting under the effect of the morphia. In sensitive patients the fauces may be painted with 2 per cent. solution

[1] *Ann. of Surg.*, October 1900.
[2] Mr. Makins' *Operative Surgery*, Burghard, p. 521.

of cocaine. Although the patient has been vomiting frequently in small quantities, the contents of the intestine rapidly regurgitate into the stomach, which may be found to contain several pints of offensive material. The evacuation of this reduces the danger of regurgitation under the anæsthetic, and the aspiration of the vomit into the lungs. This has not infrequently led to choking, and in other cases to septic broncho-pneumonia. In most cases saline infusion is also commenced. About two pints of normal saline are introduced into the axillæ by means of the Lane infusion apparatus. The temperature of the solution, as it is introduced into the rubber bag, should be 105° F. This allows for some cooling before it reaches the tissues, when the temperature should be a little above that of the body. Axillary infusion is to be preferred to intravenous and is much simpler and safer. Rectal salines by distending the colon may add to the difficulties of the exploration. Every care is taken to keep the patient warm during the operation.

Anæsthetic. The question of anæsthetics in these cases is a very important one, and should be well considered. The impeded respiration due to the abdominal distension is liable to make the administration of a general anæsthetic difficult and dangerous. The tendency to vomit is another grave danger, a sudden attack during the administration having frequently caused immediate death from choking. As already mentioned, this danger can be almost abolished by washing out the stomach beforehand.

Apart from these two considerations, a general anæsthetic seems to have specially depressing effects in cases of acute intestinal obstruction. If long continued it increases shock and post-operative vomiting. For these reasons it is desirable to give as little general anæsthetic as possible. Ether given by the closed method is especially to be avoided, for it does not relax the abdominal muscles sufficiently, it induces cyanosis and is very likely to be followed by pulmonary complications and post-operative vomiting, especially in elderly patients. Ether given by the open method following morphia and atropine is more satisfactory in every way. In healthy subjects chloroform is, on the whole, the most satisfactory because of the relaxation and quiet breathing it induces. Ether may be added if the pulse fails. In bad cases spinal anæsthesia is valuable as recommended by Mr. McGavin.[1] As he points out, it lessens shock by temporarily paralysing the posterior nerve roots and preventing the depressing influences incident to the extensive peritoneal manipulations that may be necessary from reaching the central nervous system. Moreover it is rarely followed by vomiting. In some cases the anæsthesia may not be perfect, so that a little general anæsthetic may be required in addition for a few minutes. In grave cases enterostomy may be carried out under local anæsthesia with novocaine and adrenalin.

Operation. I propose to describe the operation generally first, and then to allude to its application to the chief forms of acute intestinal obstruction. The operation to be performed will necessarily vary according to the general condition of the patient, and the mode of procedure will be described under two heads : (A) Early cases, or where

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[1] *Brit. Med. Journ.*, 1911, vol. ii, p. 1638.   5 cg. of the Stovain's glucose solution are injected into the spinal canal through the second lumbar interspace by means of a Barker syringe.   Barker, *Brit. Med. Journ.*, 1912, vol. i, p. 598.

the condition of the patient is good, and (B) Late cases, or where the condition of the patient is very serious.

A. **Early Cases.** The surgeon makes an incision five inches long through the right rectus muscle close to the middle line, and beginning just above the level of the umbilicus. The anterior wall of the rectus sheath is incised, and one of its edges is separated from the muscle (Winslow); the muscle fibres are then either separated or drawn outwards; the transversalis fascia and the peritoneum are separated from the deep surface of the rectus, picked up with toothed dissecting forceps, and opened with scissors.

The peritoneum should always be well lifted up before it is opened, especially if there is distended bowel beneath. The opening is then enlarged with curved blunt-pointed scissors, two fingers with the palmar aspect turned upwards serving as the best director.

I strongly advise the surgeon to give himself plenty of room, so as to get his hand in quickly and explore efficiently. A short median incision below the umbilicus, and the introduction of a couple of fingers, is usually futile. If the case has been allowed to go on until the intestines are distended, the search for the cause of the mischief will be rendered all the more difficult, and there must be sufficient room to introduce the hand freely. If an assistant skilfully keeps the edges of the wound together where this is not occupied by the inserted wrist, the intestines will not escape.

The surgeon should now decide which mode of exploration he will make use of. The following is as useful as any : If the parts are not much distended, three possible sites of strangulation should be first examined. (1) The cæcum,[1] which will give twofold evidence, first, its distension or emptiness telling whether the obstruction is above or below it; and secondly, the state of its appendix, whether normal or adherent and acting as a band. (2) The pelvis is next examined, as bands are often fixed hereabouts, and also because, in women, local peritonitis, originating about the uterus or its appendages, and, in either sex, about the appendix cæci, is often the cause of the obstruction. (3) Next, the internal inguinal, the femoral, and obturator rings are explored, to make sure that no tiny hernia exists, imperceptible from the outside. The fingers are next swept upwards towards the (4) umbilicus, in the hope of finding one of the diverticular bands mentioned at p. 334. If an empty coil of small intestine be fortunately discovered, it should be followed up to the obstruction, which will probably be not far away. This method is far easier than following a distended coil.

If the search fail—and it often will when distension is present, embarrassing the fingers in their movements, and obscuring the relation of parts—one or two of the loops which lie nearest to the wound should be carefully scrutinised. The late Mr. Greig Smith said that as the most distended coils just above the obstruction will rise nearest the surface, and as the greater amount of the small intestine is within three inches of the umbilicus, there is a probability that the most dilated coils will be in sight. These should be followed in the direction of increasing congestion and distension, thus leading to the obstruction.

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[1] If the cæcum can be made out to be empty, tracing up empty coils from this will very likely lead to the obstruction. The more marked the evidence of collapsed small intestine, the greater the probability of the obstruction being high up, and the less fit the case for enterostomy.

Fixity of a coil may be another aid. Where there is ground to believe that the case may be one of acute supervening upon chronic obstruction, the sigmoid and colon should be first investigated. When the transverse colon is distended and the sigmoid empty, the obstruction will be found at the splenic flexure on passing the hand well upwards and backwards towards the spleen; it must not be forgotten that the colon below the obstruction may be distended from an enema.

If a search for five minutes has failed[1] to find the cause of obstruction, the following courses remain open : (A) Kummell's plan of allowing the small intestines to prolapse under warm and moist aseptic towels; (B) emptying the most distended coil, and either closing the opening after finding and removing the cause of obstruction, or (C) tying in it a Paul's tube ; (D) " short-circuiting."

(A) The objection to this method is, of course, that it is often exceedingly difficult to get the distended coils back into the abdomen, and that the necessary manipulations and exposure must produce shock, and may inflict serious damage. If, however, the condition of the patient is satisfactory and the amount of distension not great, it is, if done properly, speedily, and with care to prevent undue exposure of, and damage to, the intestines, the quickest and wisest course to pursue. This practice was, moreover, recommended by no less an authority than Sir F. Treves, who considers that the damage done to the intestines, by the amount of exposure necessary, is probably less than that caused by prolonged manipulations within the abdominal cavity. The abdominal incision should be made very free, and the intestines then allowed to escape between smooth-surfaced sterile towels, wrung out of salt solution at a temperature of 110° F. In this way the intestines can be immediately covered with the towels, and the further search for the cause of obstruction conducted with very little exposure or interference. Usually the seat of obstruction will be quickly indicated by the fixity of some loop of intestine, which thus will not leave the abdomen. I have found this method very valuable in early cases with only moderate distension; it saves a great deal of time and allows the operation to be completed in a few minutes. To get the intestines back the abdominal wall is held well up, and if necessary a moist gauze roll may be used, for this by clinging to the intestine facilitates the replacement.

(B) Should, however, the amount of distension be very great, it is wiser to relieve this condition before proceeding further. To this end a different method must be adopted according to the seat of greatest distension. Should this be the *large intestine*, for instance, in a case of volvulus, the distended loop, carefully isolated with packing, may be emptied by puncture with a trocar with a rubber tube attached, such as is often used for tapping the chest or the gall-bladder. Frequently a large quantity of gas escapes, and the intestine collapses. In some cases liquid fæces also are conducted away through the rubber tube without contaminating the wound. As the trocar is withdrawn a purse-string suture, previously inserted, is tied, avoiding all leakage.

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[1] " The difficulty of finding the obstruction in some cases is well shown by Madelung, who, in several cases where the seat of obstruction could not be located during life, requested the pathologist, when he made the post-mortems, to locate the obstruction by introducing his hand through an incision, allowing him from ten to twenty minutes for the exploration ; in every instance he failed to find the obstruction within the specified times."— Senn, *loc. supra cit.*

To relieve the gaseous distension of a volvulus, when the trocar is not available, the isolated loop may be punctured with an ordinary cutting needle or the point of the scalpel. If the cause of obstruction cannot be found, or if it proves to be a growth of the colon, a temporary or permanent colostomy should be performed, *see* Chapter XVIII, or a short-circuit made in suitable cases, *see* Chapter XIX. In some cases of irremovable growth, when the patient has a great abhorrence of colostomy, ileo-rectostomy may be performed, as shown in Fig. 181.
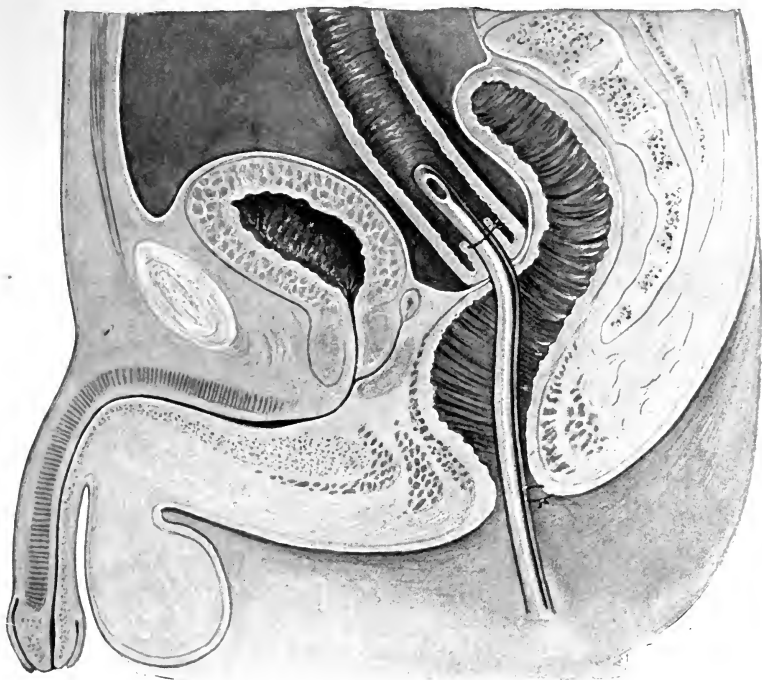
FIG. 181. Ileo-rectostomy. A rubber tube is fixed in the ileum about 10 inches from the ileo-cæcal valve. The tube is drawn through an incision on the anterior wall of the rectum below a growth in the pelvic colon. It is drawn well down and sewn to the anus, so as to maintain serous apposition between the ileum and rectum.

The ileum need not be divided, the tube can be inserted as in Fig. 183, with a few sero-muscular invaginating sutures added.

If, on the other hand, it is found that the *small intestine* is the seat of most distension, then very little advantage will be gained by either puncture or incision, for the acute flexures caused by the distension will prevent more than a very small portion of the gut being emptied by each incision. In this case it is necessary to empty the bowel of its poisonous contents either by squeezing them through a temporary opening in the bowel with the aid of a Moynihan's long tube (*see* Fig. 182), or, if the condition of the patient is very grave, by tying in an enterostomy tube for a few days. In many cases it is necessary to do this although the cause of the obstruction has been removed, for the distended bowel will not recover its power without free drainage.

(C) Where the patient's condition makes any further search impossible, or where there is great distension, a temporary or permanent artificial anus must be made. (D) *Short-circuiting* is rarely suitable for *acute* intestinal obstruction. It will be remembered that I am speaking of short-circuiting as one of the courses open to a surgeon when he fails to find the cause of an acute intestinal obstruction, or rather, of an acute supervening upon a chronic obstruction. It is evident that it is only to a few cases that this method is suitable—*e.g.* cases of matting together of coils of small intestine, as after previous mischief set up by a mesenteric gland, or appendicitis. In such cases if there is inextricable matting, but no recent inflammatory changes and nothing like gangrene, a coil of the distended small intestine may be short-circuited to the most conveniently placed piece of healthy intestine beyond the obstruction. In the majority of cases where the surgeon cannot find the cause, some part of the small intestine will be suffering not from chronic matting

Fig. 182. Moynihan's tube.

as above, but from the pressure effects of some band, orifice in the omentum, &c., and softening, or even gangrene, may be impending; then a safer and better plan to relieve the distended intestine will be by performing enterostomy, as described in Chapter XVIII. (*see* Fig. 183). A drainage-tube is inserted at the lower angle of the wound if the peritoneum has been contaminated. The opening in the abdominal walls is rapidly closed. In early and favourable cases the wound may be sewn up in three layers in the usual way. In grave cases only stout salmon-gut sutures piercing all the layers are used; and these are introduced rapidly with very large curved needles, while the parietes are held up away from the intestines.

B. **Late Cases.** Here the condition of the patient will not allow of any but the briefest operation. After the injection of novocain and adrenalin solution a small incision, two inches long, is made in the median line below the umbilicus. On opening the peritoneum the most distended coil projects into the wound. If not, two fingers are introduced and carefully feel for the most distended coil within reach, and bring this up into the incision. This must now be opened and an artificial anus formed, a small Paul's tube being tied in and the fluid contents of the intestine conducted away through a long rubber tube already attached.

It may happen that this plan will result in the opening of a coil some distance above the obstruction, or that the obstructed portion of intestine is already gangrenous. In the former case relief is usually afforded, but in the latter the gangrenous loop perforates and almost inevitably leads to fatal peritonitis. On the other hand, it may be urged that in these extreme cases, further interference would be almost certainly fatal, even though the cause of obstruction were removed, and, moreover, that the most distended coils of intestine usually rise

to the surface and are situated close to the umbilicus ; and, finally, that many lives have certainly been saved by this means.

Having spoken of the operation generally, I shall next refer to a few practical points connected with the chief causes of obstruction individually.
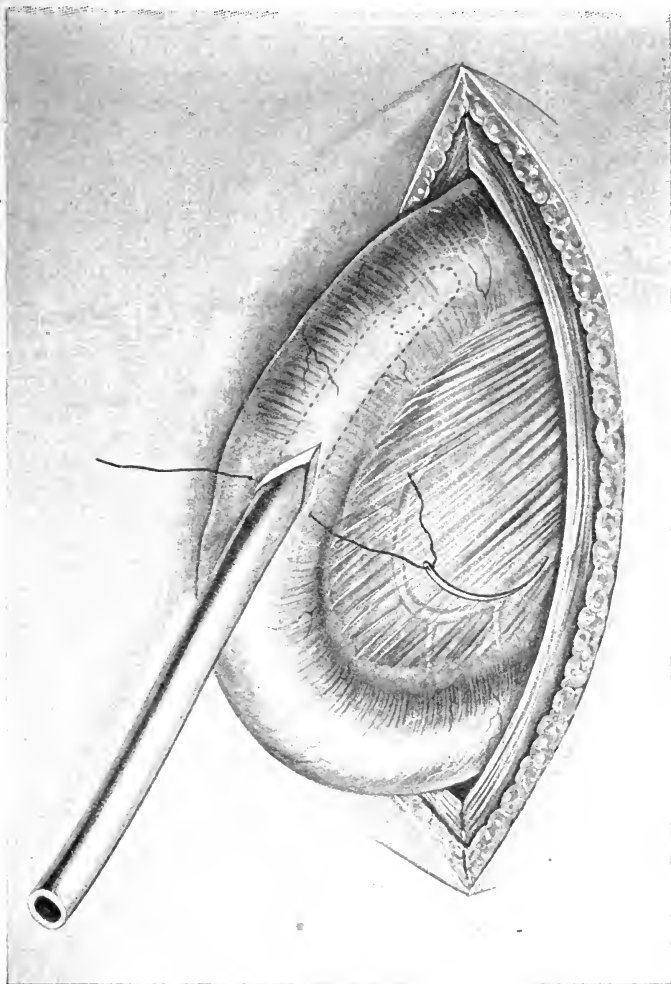
Fig. 183. Another method of enterostomy. The rubber tube is passed upwards and fixed by a single catgut suture. A few turns of a sero-muscular suture prevent any leakage by the side of this tube. The bowel is returned into the abdomen, and the parietal wound is almost completely closed round the tube. The latter must be long enough to reach a receptacle under the bed. The tube comes away after 4 or 5 days, and the fistula heals spontaneously unless the bowel below is obstructed.

I. Strangulation by Bands and through Apertures.[1]   A. Bands.
(1) Adventitious Peritoneal Bands. Perhaps there has been a history

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[1] Sir F. Treves (*Intest. Obstruct.*, p. 13 ; *Dict. of Surg.*, vol. ii, p. 802) groups these together from the similarity of their obstruction and their close resemblance to strangulated hernia.

of peritonitis, starting possibly from the appendix, the uterus, and appendages, or a mesenteric gland. These bands are usually attached by one end to the mesentery. (2) Omental Bands. Here some part of the lower end of the omentum has become adherent to the brim of the pelvis, a hernial orifice, a uterine appendage, the cæcum, or a tuberculous mesenteric gland. (3) Meckel's Diverticulum.[1] This is usually met with in young subjects. Tubular or cord-like, it will be found attached at one end to the ileum, within three feet of the cæcum; at the other near the umbilicus or to the mesentery or intestine. Under this arch small intestine is very liable to slip. In other cases one end is free, and ensnares or knots up a loop of intestine. (4) *Some Normal Structure abnormally attached, e.g. the Fallopian Tube or the Appendix.*

In most cases bands, when found, are not difficult to deal with. If they do not give way to the finger as attempts are made to hook them up, they should be divided between two ligatures. Occasionally transfixion is required. When one band has been discovered, the possibility of a second, attached to the pelvic brim, must always be remembered. In Gibson's list of cases there are 186 of obstruction by bands, and in no less than thirty-three of these there was a record of more than one band being present, and it is probable that the proportion is even higher than this.

Two other points connected with bands must be remembered: one, that, if they are vascular both ends should be secured; the other, that on the division of the band the piece of intestine which has been released may be found to be gangrenous or even perforated, and allowing its contents to escape into the peritoneal sac. The intestine must then be brought outside and drained, and the peritoneal sac cleansed.

Every band should be resected as closely to its attached points as is safe, to prevent any recurrence of the trouble.

CASE I. *Acute Intestinal Obstruction by a Band : Appendix adherent to Caseous Mesenteric Gland.* Boy, aged 6 years. The patient was seized with very violent pain in the abdomen on the morning of April 10, 1911. His father gave him two large doses of castor-oil, which failed to have the desired effect. He was admitted into Guy's Hospital; and had a subnormal temperature, and was blue, cold, and pulseless. His abdomen was considerably distended, but flaccid. It was full in the flanks, and there was a palpable swelling in the right iliac region. On admission, at 8 A.M. on the 11th, he was too bad for operation, and was therefore infused into the axillæ.

Operation. The abdomen was opened at 9.30 A.M., the patient having been given ether. The lower part of the right rectus was displaced inwards. The peritoneum seemed to be purplish and clearly contained blood. It was opened, and a large amount of sanious fluid escaped, clearly showing that the condition was one of intestinal obstruction and not appendicitis. Dark purplish, but not gangrenous, coils of small intestine were at once seen. Several coils were withdrawn, and a band was seen, consisting of the appendix adherent to a caseous mesenteric gland. This was astride the lower end of the ileum close to the cæcum and completely obstructed it. The adhesion to the tip of the appendix was divided and the empty cæcum drawn away from its former position, which was unusually high. The abdomen was then closed with through and through salmon-gut sutures. The operation lasted seven minutes (the patient was only in the theatre ten minutes). He was not much worse at the end of the operation, but the infusion which was carried on throughout the operation was continued. Pituitary extract was injected in 5 m. doses. The patient rapidly recovered.

Meckel's Diverticulum. This may act as a band over the intestine, and the fœtal relic may become twisted at its base. The diverticulum

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[1] For an account of other surgical conditions due to Meckel's Diverticulum, *vide* pp. 335 and 432.

is usually within three feet of the ileo-cæcal valve. There is often a history of previous attacks of colic, and a diagnosis of appendicitis has often been suggested. In the case of a diverticular band which is tubular, the neighbouring intestines and the abdominal wall are protected with gauze packs and the diverticulum is divided between two clamps near its base. The stump is cleaned with methylated spirit and closed with two continuous sutures of fine linen thread. When the diverticulum is narrow the simplest and most rapid way is to crush, tie, and bury the stump by means of one or two purse-string sutures passing through the sero-muscular coats round the base.

In some cases gangrene of the ileum occurs at the twisted base of the diverticulum, and then a resection, with or without intestinal drainage, will have to be undertaken, unless the area of gangrene is so small that inversion can be performed without risk of narrowing the lumen too much.

A most interesting and fully reported case successfully treated by laparotomy was published in the *Lancet*, March 9, 1889, by my old friend R. J. Pye-Smith, of Sheffield. Two others successfully treated in the same way by Mr. Clutton [1] and Mr. McGill [2] will well repay reference.

Dr. Roberts [3] records two interesting cases. One patient was a boy of 4½ years who was treated by operation after four days' obstruction. A slender diverticulum was discovered about three feet from the ileo-cæcal valve. " Its diameter was less than that of the vermiform appendix. Its end was a mere fibrous cord attached to the abdominal wall near the umbilicus. The structure was distended at its middle into a sac similar to that which is sometimes seen in the appendix when it is inflamed. Between the sac and the ileum there was a patent tube lined with mucous membrane. There was evidence of inflammation of these structures. The ileum, a short distance from the point of origin of the diverticulum, was tightly strangulated by the passage of the diverticulum and its fibrous continuation across it. A deep groove was thus made in the portion of the bowel opposite the mesentery, similar to that often seen in cases of tightly strangulated hernia at the femoral or inguinal ring." The diverticulum and its fibrous prolongation were removed, and the groove on the intestine was inverted by means of Lembert sutures, because it was so dark that sloughing and perforation were feared. The boy recovered after a severe illness.

I operated for acute obstruction due to this cause in a baby of three weeks. The child died, the abdomen being greatly distended and containing a large amount of sanious fluid at the time of the operation. In this case the diverticulum originating within a foot of the ileo-cæcal valve, terminated upon the mesentery of a portion of the ileum, which it passed over and strangulated.

This is a very fatal form of obstruction, chiefly because of mistakes in diagnosis and delay in operating.

Gibson found the mortality to be 55 per cent. in forty-two operations for intestinal obstruction due to this structure.

B. **Apertures and Slits.** These may be congenital or traumatic, the intestine entering and enlarging a congenital retro-peritoneal fossa, or slipping through a rent in the mesentery, omentum, or diaphragm.

(a) **Retro-peritoneal Hernia.** For most of the information upon this subject I am indebted to the valuable, scientific, and exhaustive work of Moynihan and Dobson.[4]

The chief varieties are :

(1) The left duodenal, of which over sixty cases have been recorded.

(2) The right duodenal, of which over seventeen cases have been recorded.

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[1] *Clin. Soc. Trans.*, vol. xvii, p. 186.   [2] *Brit. Med. Journ.*, January 14, 1888.
[3] *Ann. of Surg.*, vol. ii, 1906, p. 87.
[4] *Retro-Peritoneal Hernia*, Moynihan and Dobson, 1906.

(3) The mesocolic, of which only one certain case has been recorded (Dobson), and possibly that described by Sir Astley Cooper years ago.

(4) The infra-duodenal, of which Molin has described the solitary recorded instance.

All these arise in the neighbourhood of the termination of the duodenum, *the left duodenal* hernia occurring into the para-duodenal fossa of Landzert, which *has the inferior mesenteric vein in its prominent left, lower, and upper borders. The right duodenal* which occurs into the mesenterico-parietal fossa of Waldeyer, which lies in the root of the mesentery of the upper part of the jejunum, and has the *superior mesenteric artery in its prominent anterior border.* The mesocolic hernia is to the left of the inferior mesenteric vein ; the infra-duodenal lies below the duodenum, and has no vessels in the prominent edge of its orifice.

The left duodenal hernia enlarges upwards and to the left towards the spleen, its orifice being placed antero-internally in small herniæ, and postero-internally in larger ones.

The right duodenal enlarges downwards and to the right towards the right iliac fossa, its orifice being directed upwards and to the left. Duodenal herniæ nearly always contain only small intestine, but Freeman[1] has recorded a case in which the entire small intestine, the cæcum, and a part of the colon had passed into a left duodenal hernia.

(5) *The pericæcal*, which may be subdivided into the ileo-appendicular, of which seven cases are recorded ; the retro-colic, of which eight cases are recorded ; the hernia into the fossa of Hartmann, which is a fossa placed between the mesentery of the appendix and a continuation of the mesentery of the small intestines to the iliac fossa ; one possible case is recorded.

Hernia into the sub-facial or iliac fossa, which is a pouch of peritoneum pushed downwards through a weak spot in the iliac fascia, and outside the psoas muscle ; two cases of this are recorded, and Mr. Dunn operated upon another one at Guy's Hospital some years ago.

(6) The intersigmoid. Only two genuine cases are recorded, those of Eve and Macadam Eccles.

(7) The hernia into the lesser sac of the peritoneum, twelve instances of which are recorded.

Diagnosis will generally be arrived at only during a laparotomy for the relief of intestinal obstruction, but in some cases such as that of Sherren, a diagnosis has been made before the operation.

In addition to the classical symptoms and signs of acute intestinal obstruction, other points may suggest or even strongly indicate a retro-peritoneal hernia.

The existence of a duodenal hernia may be indicated by the presence of a " palpable definite resonant mass " at the upper and left part of the abdomen (left duodenal hernia), or at the lower and right part (right duodenal hernia).

This mass does not move on respiration, and coils of intestine may be evident towards the middle of the swelling, the size of which may vary with the severity of the symptoms.

Hæmorrhoids or rectal hæmorrhage may develop in left duodenal hernia from obstruction of the inferior mesenteric vein.

Only one case of pericæcal hernia has been diagnosed before

[1] *Amer. Journ. Med. Sci.*, October 1903.

operation, from the presence of a mass in the right iliac fossa, which was rendered more evident by means of rectal injection (Riese).

Hernia through the foramen of Winslow may be indicated by agonising pain in the epigastrium, where a semi-resonant tumour may soon appear.

Treatment. When the nature of the obstruction has been recognised, attempts should be made to reduce the hernia by a combination of pressure upon the sac and gentle traction upon the intestine. In some cases it may be possible to enlarge the orifice by stretching, in others the prominent margin may be divided, due care being taken to avoid any prominent blood-vessels. In left and right duodenal hernia it may not be possible to enlarge the opening without injuring the inferior mesenteric vein in the one case, or the superior mesenteric vessels in the other. Haberer in his successful case divided the inferior mesenteric vein, which he then found to be already thrombosed.

The foramen of Winslow is not capable of enlargement, surrounded as it is by the liver above, the vena cava behind, the twist of the hepatic artery below and the portal vein, bile duct, and hepatic artery in front. The difficulties that may be met with are illustrated by Sir Frederick Treves' case.[1]

Here the surgeon not only failed to reduce the gut by operation during life, but at the necropsy he could not bring about reduction until the hepatic artery, portal vein, and bile duct were severed.

Incision of the anterior layer of the gastro-hepatic omentum and retraction of the first part of the duodenum with the view of enlarging the opening is considered by Moynihan to be impracticable in cases of obstruction, and I do not believe that it would be any good, for the twist of the hepatic artery would still form the lower boundary of the ring.

Mobilisation of the duodenum by incising the posterior parietal peritoneum to the right of it and detaching it forwards and downwards enlarges the orifice according to Moynihan, but he considers this measure to be almost out of the question in a patient suffering from acute intestinal obstruction.

When the rings cannot be enlarged by stretching, and vessels prevent an incision being made, it is best to open the sac anteriorly and to try to reduce the bowel from within. This may only be practicable after pulling out a loop of distended bowel and emptying it through an incision made along its convex border with all precautions against contamination of the peritoneum. The incision having been closed the reduction will probably be easily performed.

An attempt should be made to close the neck of the sac to prevent a recurrence of the hernia, and the necessity of this is shown by the recurrence in Mr. Paton's case.

It may be neither wise nor necessary to prolong the operation by attempting to close the foramen of Winslow, for a recurrence is not likely here.

Results. Successful operations for left duodenal hernia have been recorded by Sonnenberg, Tubby, Priestley Leech, Narath, Haberer, Lawford Knaggs, McArthur and Sherren, and one successful operation for right duodenal hernia by Neumann. Four operations for pericæcal hernia have been successful, one of these being the case recorded by

[1] *Oper. Surg.*, vol. i, p. 389.

Sir William Macewen, who had to resect eight inches of small intestine for gangrene.

Two successful operations for hernia at the foramen of Winslow have been recorded, but in one of these spontaneous reduction occurred after the surgeon had failed to reduce the hernia during the operation.

(b) **Traumatic apertures** may be formed in the diaphragm, omentum, mesentery, or mesocolon, and may result from crushing violence, gunshot and other wounds, or careless operations during which certain openings may not be properly closed. For instance, after gastrojejunostomy, a hernia may occur through the rent in the mesocolon, and the same thing may follow resection of intestine, unless the mesentery is properly sutured.

The following is an instance of a hernia through a hole in the mesentery.

In Mr. Howard Marsh's case [1] a loop, probably in the middle of the jejunum, had slipped through a hole in the mesentery. The edge of this opening was so yielding that Mr. Marsh could readily stretch it with his finger-nail sufficiently to allow the loop to be drawn out. The patient made a good recovery, though in much danger for a while from the paralysed condition of the intestine.

Diaphragmatic hernia occurs far more frequently on the left than on the right of the middle line ; thus in 133 instances the rupture was on the left in 100.[2]

The hernia may be traumatic or congenital in origin. Dr. Eustace Smith [3] has recorded an instance of the latter. Lickenstern has collected 250 cases of traumatic ruptures, but in only five of those was the condition recognised before death occurred.

Mackenzie and Battle [4] record a very interesting case of hernia which followed a poniard wound in the left anterior axillary line. After a slow recovery the man remained well for about three years, when he was seized with pain in the left side of the upper abdomen and severe vomiting. Several similar attacks followed, and " seven days before admission, when crossing the Channel, he suffered much from sea-sickness and had vomited almost constantly since."

The patient was greatly collapsed on admission into St. Thomas's Hospital, and he was infused. Next day an incision was made parallel to the left costal margin. The small and large intestines were found to be " empty " ; the greater part of the stomach, the splenic flexure of the colon and some omentum were found to have passed through an aperture in the muscular part of the left side of the diaphragm ; the omentum was adherent and could not be released. The stomach was reduced with great difficulty, but the colon was withdrawn with ease. The patient died after three days from peritonitis, probably arising from the site of the constriction in the stomach.

Battle and Mackenzie state that successful operations have been undertaken for diaphragmatic hernia by Llobet, Humbert Leisrink, and Mikulicz. Lawford Knaggs [5] has written an elaborate and interesting article upon the subject of hernia of the stomach through the diaphragm, of which he was able to collect sixty-three cases. Only two operations had been performed in these cases (by Knaggs and Berry), and both these failed to save life. In twenty-three cases the hernia was congenital in origin, in twenty-one traumatic, and in twelve acquired ; in the acquired cases with sac formation the stomach had protruded through or near the œsophageal opening in the midriff.

Gibson[6] collected the records of six operations for diaphragmatic

[1] Brit. Med. Journ., June 2, 1888.   [2] Boursier, quoted by Gibson, loc. infra cit.
[3] Lancet, May 22, 1904.   [4] Lancet, vol. ii, 1904, p. 1582.
[5] Lancet, vol. ii, 1904, p. 358.   [6] Ann. of Surg., 1900, vol. xxxii, p. 508.

hernia without a recovery ; in several instances the condition was not recognised even during a laparotomy. The splenic flexure, stomach, and omentum were commonly found in the ruptures, and the cæcum was present in one. The reduction was not very difficult in those cases in which it was attempted.

Diagnosis. When the strangulation chiefly concerns the stomach, the symptoms may be very characteristic, but when the obstruction is in the colon, the nature of the lesion may not be discovered until a laparotomy is performed, and it may not be suspected even then.

Sir Samuel Wilks[1] drew attention to the existence and importance of excessive thirst in cases of strangulation of the stomach ; other suggestive symptoms are urgent vomiting, scanty secretion of urine, carinated abdomen and pain in the epigastrium. In some cases there have been signs of displacement of the heart or left lung, and in others indications of pleural effusion ; or hyper-resonance of the chest with gurgling noises have been noticed.

When the obstruction concerns the colon, some of these symptoms may be absent, and the abdomen may be markedly distended.

The possibility of the existence of this rare form of hernia should be borne in mind, especially when the cause of the obstruction cannot be made out during an exploration.

Treatment. If the diagnosis of diaphragmatic hernia has been arrived at, a long incision should be made parallel with and one inch below the left costal margin, which should be well retracted. An attempt should be made to withdraw the contents of the hernia without enlarging the aperture, owing to the dangers of hæmorrhage and the difficulties of arresting it at the depth of the wound. The margins of the ring should be closed by sutures if possible. With the invaluable aid of intratracheal anæsthesia the hernia may be approached through the pleura. Even without this advantage Llobet has operated successfully through the pleura, however, and after closing the aperture in the diaphragm and the parietal wound he aspirated the air from the pleural cavity.

II. **Intussusception.** From its frequency, especially in early life, its fatality in infants, and the fact that its treatment by early and speedy operation is very satisfactory partly because its diagnosis is easier than other forms of obstruction, this deserves careful notice.

Diagnosis. Nowhere is early diagnosis more imperative. This should be based upon the following symptoms :

Sudden abdominal pain followed by shock and *spasmodic attacks of colic,* as indicated by frequent fits of crying and pallor ; *more or less frequent evacuations of blood and slime with no fæcal matter,* except quite early in the case ; *vomiting,* and perhaps a sausage-shaped tumour, discovered by abdominal or bimanual palpation. The absence of a palpable tumour is far from conclusive negative evidence, even when the abdominal wall is relaxed under the influence of chloroform, and failure to find one must not be allowed to delay an exploration indicated by more important signs and symptoms. Erdman[2] found that no tumour was palpable in 60 per cent. of his cases, either by the rectum or through the abdominal wall. I think that this experience is unusual, however. Mr. Wallace found a tumour in all of his twenty cases. A

[1] *Lancet,* 1858, vol. ii, p. 434.
[2] *New York Med. Journ.,* May 14, 1904.

dependent lobe of the liver, a mass of mesenteric glands, and a prolapsed spleen have each been mistaken for an intussusception.

Two more points must always be remembered in the diagnosis of intussusception : (1) that in cases which are not acute there may be very few symptoms for a time ; for instance, in subacute cases some fæces may pass, and a diagnosis of colitis may be made ; (2) the rectum must always be examined, and any intussusception which may be met with not mistaken for a prolapsus.

The disease should be diagnosed long before the stage of distension and collapse. Careful consideration of all the points mentioned above will usually prevent delay and enable the surgeon to avoid a mistaken diagnosis of enteritis. In cases of grave doubt the abdomen must be explored.

Treatment. If a capable surgeon is available, laparotomy should be performed without delay when the diagnosis has been made, for an early operation quickly performed is the only reliable and hopeful treatment. In very early cases reduction may be possible with comparatively little force, and may be brought about satisfactorily by injection or inflation, but the results of this treatment are so unsatisfactory and deceptive that no reliance must be placed on it, unless suitable surgical aid cannot be obtained without delay. Very soon, however, the engorgement of the intussusceptum and included mesentery, or the adhesion of the entering and returning layers as the result of peritonitis, renders reduction much more difficult or impossible. In such cases distension of the colon will either fail altogether, or will produce only partial reduction, with subsequent speedy relapse. The following figures from Gibson's list [1] will serve to emphasise this important point : 94 per cent. of the cases treated within the first twenty-four hours were reducible on abdominal section, whereas only 61 per cent. of those treated on the third day were reducible. The proportion reducible by *distension* would necessarily have been less than the above in each case.

The following results of distension will also serve to emphasise the importance of not wasting time in attempting to reduce an intussusception by injection or inflation. Eve collected twenty-four cases from the records of the London Hospital in which distension was tried. Of these six died without further treatment, and the remaining eighteen required operation. Mr. Barker [2] tried distension in eight cases, in all of which it failed ; and in a collection of cases by Wiggins distension failed in 75 per cent. of seventy-two cases in which it was tried.

Moreover, the following *objections* to distension must not be lost sight of : (1) The danger of sudden collapse or rupture of the bowel ; (2) the loss of valuable time, rendering the result of a laparotomy less likely to be successful ; (3) it will be of no use in enteric intussusceptions (which form 22 per cent. of all cases), and probably of no use in ileo-colic intussusceptions (which form 12 per cent.), so that in 34 per cent., or in one case in every three, it is practically certain to fail ; (4) there is no certain means of telling at once that the injection has been successful ; the disappearance of the tumour, if any, is not reliable, for the proximal first few inches may not be palpable ; the bowels may not be opened for a day or more after a satisfactory reduction.

[1] *Loc. supra cit.*   [2] *Clin. Soc. Trans.*, vol. xxxi.

At St. Thomas's Hospital between 1892 and 1901 the mortality in sixty-two patients under one year of age was thirty-eight, or 62·29 per cent., but in the last three of those years, when cœliotomy became primary as a routine measure, the mortality was only 47·5 per cent.

In cases of less than twenty-four hours' duration, distension of the bowel is still used by some surgeons as an auxiliary, but not as a substitute for laparotomy. Mr. Kellock has recommended this method as a means of reducing the greater part of the invagination just before the abdomen is opened. The manipulations and exposure of the intestine and the duration of the operation may be thus lessened. I consider these advantages to be uncertain, and to be more than balanced by the increased abdominal distension and the prolongation of the anæsthetic —a grave thing in these cases. Moreover, the finger of an assistant or a bougie in the rectum give all the aid that may be required to displace the invagination out of the pelvis.[1]

Personally, I never attempt to distend the intestine, even as a preliminary, but proceed to operate as soon as the necessary preparations can be made.

Operation. This should be conducted with as much speed as is consistent with safety, the child should be exposed as little as possible, the limbs are surrounded with cotton-wool and firmly bandaged, and all preparations should be completed before the chloroform is administered. Plenty of sutures should be threaded ready for immediate use, for every moment of time saved is of value,

FIG. 184. Diagram of an intussusception in vertical section. M, Mesentery. A, Artery. V, Vein. D.V. Dilated vein. I.M. inflamed mesentery. OR. Orifice of bowel at apex of intussusceptum with thickened mucous membrane around. A, Line drawn through usual seat of adhesions. B, Line for resection of intussusceptum. x x, To mark the vertical incision through which resection is performed. (Greig Smith.)

and the prognosis varies inversely with the length of time that the patient is upon the operating table. All aseptic towels used should be dry and warm, so that the child may not be chilled by evaporation ; the table should, of course, be warm.

An incision about three inches long is made over the right rectus muscle ; the centre of the wound should be about three-quarters of an inch below and to the right of the umbilicus.[2]

This incision gives better access to the seat of origin of the great majority of intussusceptions in children, for they nearly all start near the cæcum, to whatever variety ingenious classification may refer them.[3]

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[1] C. H. Fagge, *Clin. Soc. Trans.*, vol. xxxviii.   [2] Wallace. *loc. infra cit.*
[3] E. M. Corner (*Ann. of Surg.*, November 1903) concludes that double intussusceptions are more common than single, but the experience of other observers does not confirm

The reduction of the most difficult part can thus be performed within sight—a very important thing.

The rectus sheath is incised, and one edge of it is rapidly raised from the muscle to facilitate overlapping later on. The muscle fibres are separated by blunt dissection to avoid delay from hæmorrhage, if possible.

The posterior layer of the rectus sheath and the attached peritoneum are incised to the extent of two inches, and an attempt is then made to discover the intussusception and to hook it into the wound by means of one or two fingers. In most cases this is not possible, for the mass is usually tethered back to the spine by the invaginated mesentery. In these cases the peritoneal incision must be enlarged, and then most of the reduction can be easily and safely performed within the abdomen, the finger and thumb gently compressing the distal part of the tumour, which is pushed towards the proximal end at the same time.

In some cases I have been able to reduce the greater part of the invagination by bimanual compression, the intussusception being squeezed between the fingers of the right hand within and the left hand outside the abdomen. Care must be taken to prevent the escape of coils of small intestine.[1]

Early and small invaginations may be brought into the wound at once, and towards the end all reductions can and should be performed with the aid of sight ; otherwise serious damage may be done to the bowel. This part of the reduction must be conducted with care, and traction on the entering intestine must not be made, except with the utmost gentleness ; the ensheathing layer should be fixed below the presenting point, and then it will usually be found that pushing or backing out the contained bowel by gentle squeezing movements between the finger and thumb, these being gradually shifted along the gut, will prove successful, when by no force that is justifiable could any part be drawn out.

Whichever method is found to answer best must be persevered with until every atom of the mass is reduced, this being often known by the appearance of the vermiform appendix. Care must be taken to avoid leaving unreduced the apex of the intussusception, which is often in the ileum about two inches from the cæcum. This part may project into the colon after the cæcum and appendix have resumed their natural positions. I believe this error to be the cause of so-called early recurrences.

If, when the reduction is complete, any tears are noticed in the peritoneal coat, these must be sewn up with a fine continuous suture, and any thin or grey lines should be inverted by Lembert sutures to prevent perforation or infection, and to avoid the need of enterectomy in some cases. To prevent recurrence if time permits, Moynihan

this view. I agree with him that the ileo-colic is the commonest primary variety, the last part of the ileum becoming gripped in the ileo-cæcal valve. He considers that the primary ileo-cæcal variety is decidedly rare, and almost limited to chronic cases, the recorded cases probably starting in the last few inches of the colon or the cæcum.

[1] Mr. Wallace (*Clin. Soc. Trans.*, vol. xxxviii, p. 59) makes no attempt to retain the intestines in the abdomen, and if they escape he simply covers them with warm sponges. Mr. Wallace's results are very good, but all the surgeons who have to do this operation are not so skilful and expeditious as he is, and I have no doubt whatever that to allow the intestines to protrude is a mistake, for it may be very difficult to replace them, and much valuable time may be thus wasted. Moreover, shock is greatly increased by the exposure, traction on the mesenteric plexuses, and the manipulations necessary for reduction.

sometimes passes a few sutures uniting the cæcum and the peritoneum of the right iliac fossa,[1] and with the same object Dr. McGregor[2] pleats and shortens the lengthened mesentery of an enteric intussusception. Fortunately true recurrence is very rare after complete reduction. The starting-point is palpated for a possible polyp or inverted Meckel's diverticulum. If either of these be found it must be removed through a small longitudinal incision to be later closed transversely. This was successfully done for an infant by my friend, Mr. O. V. Payne, of Alton, some years ago. Mr. Rutherford Morison has successfully removed a Meckel's diverticulum in a similar way from a boy aged 5 thirty-four hours after the onset of symptoms.[3] He also resected a piece of the lower end of the ileum containing an adenomatous polyp in a man aged 62, the subject of chronic intussusception.

The wound should be rapidly closed by means of a continuous catgut suture for the peritoneum and deeper fibres of the rectus and inter-rupted fishing-gut sutures for the remaining layers. When the wound is sewn up in layers without the aid of these supporting sutures there is some risk that the wound may reopen, allowing the intestines to escape. This happened to two of three cases in which Mr. Wallace relied upon three layers of catgut sutures.[4]

A warm saline enema may be given immediately after the patient has returned to bed, and every effort · must be made to prevent and combat shock both during and after the operation ; saline infusions into the cellular tissues of the axillæ and the subcutaneous injection of pituitary extract should be given in bad cases.

Feeding with diluted milk and albumen water should be commenced as soon as possible after the operation, as long as vomiting does not occur, for starvation is one of the serious factors in these cases. No purgative is given. The bowels generally act naturally within two days ; if not, a soap enema is administered.

When the intussusception cannot be reduced, all attempts at traction and kneading only causing tears in the peritoneal coat, the following courses are open according to the condition of the patient, &c. : (1) *If the intussusception is gangrenous*, it should be rapidly resected. Most surgeons now prefer to use sutures only. Whatever method is used, some difficulty must be expected in effecting exact union in the common variety, the ileo-cæcal, owing to the difference of the lumen in the two parts of the bowel ; where this difficulty is very marked, the best plan will be to close both ends by a ligature and two purse-string sero-muscular invaginating sutures, and then to make a lateral anastomosis by means of direct suture. (2) *If the invagination is irreducible but not gangrenous*, it may be left, and the continuity of the canal restored by short-circuiting the small and large intestine above and below the invagination. A radical operation may be required after the acute obstruction has been relieved. (3) *Where the patient's condition is good, especially in chronic cases*, an irre-ducible intussusception is best treated by an operation based by Mr. Jessett[5] on what is known as spontaneous cure. It was three times performed successfully on dogs. An invagination having been made artificially, and found a week later firmly adherent, it was thus removed. A longi-tudinal opening was made into the intestine over the root of the intus-

[1] *Abdominal Operations*, p. 479. [2] *Loc. cit.*
[3] *Lancet*, 1902, vol. i, p. 1689. [4] *Loc. cit.*
[5] *Surg. Dis. of Stomach and Intestines*, p. 140.

susception on the side farthest from the mesentery, about an inch and a half long, of sufficient length to allow the invaginated part to be drawn out with vulsellum forceps. The root of the invaginated part having been pulled out through the above opening, was cut through close to its origin, any vessel which required it being tied. Then the divided coats where the intussusception had been cut away were united with a few points of suture, the lumen of the bowel being left open (*see* Fig. 185). The stump was then returned into the intestine, and the incision in this closed by quilt sutures. Greig Smith[1] recommended this method of treatment, but modified the operation in cases of extensive invagination in that he removed only the apex of the intussusceptum, this being the most swollen part, and therefore the chief obstacle to reduction. The rest was then gently reduced. Although reduction will be rendered possible in some cases by removal
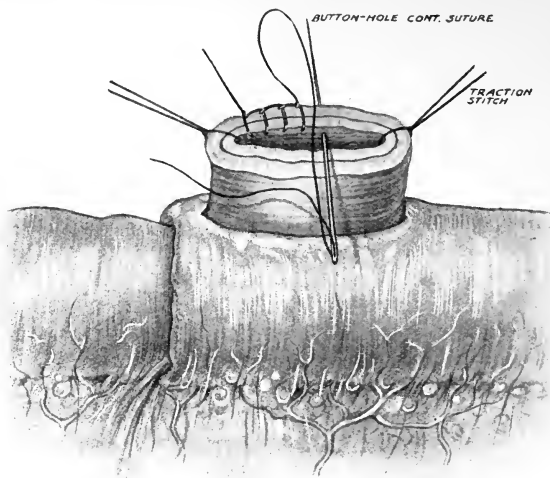
FIG. 185. Excision of gangrenous intussuscipiens through the wall of the ensheathing bowel. The stump is sewn as in Maunsell's operation, the stump is withdrawn, and the longitudinal incision closed in the usual way.

of the apex of the intussusceptum, in others the adhesion of the layers at the neck of the intussusception to one another will make reduction impossible. In such cases, a more complete resection of the intussusceptum will be necessary. Israel[2] advocates a modification of the method just described : he first fixes the intussusception to the parietal peritoneum, and then resects the invagination through a longitudinal incision, which is now extra-peritoneal ; the incision in the bowel is left open for a few days for drainage. Israel has had two successful cases with this operation. Other and less desirable methods which may be thrust on the surgeon, owing to the circumstances under which he operates, are : (4) *Resection and formation of an artificial anus*,[3] for in late cases free drainage for a few days is essential to success. (5) *Formation of an artificial anus without resection*, which is not recommended

[1] *Abdom. Surg.*, p. 676.　　　　　　　[2] *Med. Record*, May 20, 1905.
[3] Prof. Senn quotes a case of Wassiljew's (*Centr. f. Chir.*, 1888, No. 12), in which an operation was performed to close the artificial anus six months later. It was ultimately successful.

under any circumstances, for the primary mortality is as great as that of resection, and the mortality of secondary resections is high (about 50 per cent., Gibson) in these cases. Finally, in those rare cases of invagination of the colon into the rectum, the intussusception may be drawn down and removed by the operations of Mikulicz or Mr. Barker in this country. The latter surgeon's cases will be found in the *Med. Chir. Trans.*, 1887, vol. lxx, p. 335, and *Brit. Med. Journ.*, vol. ii, 1892, p. 1226. In both cases a malignant growth was the cause of the invagination, and in each operation steps were facilitated by the ease with which the growth, after dilatation of the anus, could be pulled outside. Two rows of sutures were made to encircle the bowel, and to unite the two layers of the intussusception firmly together well above the new growth. As the sutures were passed, care was taken that no small intestines protruded. Both cases recovered, and the first was alive four or five years after the operation. The writer performed a similar operation for an impacted intussusception of a carcinoma, which could be neither drawn out of the anus nor back into the abdomen. The anus was slit backwards sufficiently for a successful resection to be carried out. For over two years the patient was in perfect health, but he soon afterwards returned with an irremovable growth in the anal scar extending deeply into the pelvic floor.[1]

Mortality. In considering this, it must be remembered that every recovery means a life saved from almost certain death. Earlier diagnosis and above all earlier resort to primary operation have greatly improved the prognosis. Wallace[2] records twenty consecutive cases with only four deaths, a mortality of only 20 per cent., or excluding the cases severe and late enough to require resection, 11·11 per cent. The average duration of the operation in eleven cases was fourteen minutes, and this list included one of resection, and also one of excision of a gangrenous appendix.

Fagge reports eighteen cases with six deaths, a mortality of 33 per cent., but he was unfortunate in meeting many gangrenous cases, and if these late cases be excluded the mortality is only 15·4 per cent.

Clubbe[3] gives an account of 100 consecutive laparotomies for intussusception. Of the first fifty, twenty-five died, whereas of the last fifty only twelve died, owing to the children being sent into the hospital earlier, and to improvements in treatment.

In the first fifty cases the average duration of time before operation in the successful cases was twenty-eight hours; in the unsuccessful sixty-eight hours. In the second fifty cases the average duration was twenty-three hours for the successful and forty-eight for the unsuccessful cases.

Rigby records seven cases,[4] one of which was too late for operation, and one needed resection; the other five recovered. In none of the cases did the operation last more than fifteen minutes.

Adams[5] discusses 100 cases occurring at St. Thomas's Hospital during the last eighteen years. Of ninety-one treated by operation, fifty-nine recovered.

G. Owen[6] records a case in which a recurrence occurred within twenty-

[1] *Med. Pren. and Circ.*, 1910.
[2] *Clin. Soc. Trans.*, vol. xxxviii.
[3] *British Med. Journ.*, January 17, 1905.
[4] *Lancet*, January 14, 1902.
[5] *Pract.*, 1910, p. 679.
[6] *Intercolonial Med. Journ. of Australasia*, October 20, 1902.

four hours of the operation; the second operation did not save the child.

Cole[1] mentions a case in which a second operation proved successful.

Erdman[2] removed the appendix in all his eleven cases, because it formed a part of the intussusception. This is not to be recommended unless the appendix is dangerously damaged, for the delay may be serious. Keetley recommends an appendicostomy as a means of drainage, feeding, and prevention of recurrence. In rare cases of great distension this may be wisely done.

Recovery after resection of a gangrenous intussusception is a very rare event. Thus Gibson[3] in his collection of 1000 cases of intestinal obstruction found only one case of recovery after resection for this condition. In an earlier collection in 1897 there were 239 cases of intussusception, with no recovery from *irreducible* intussusception in a patient under seven years of age, and only nine in older people.

W. H. Brown[4] records a remarkable case of an enteric irreducible intussusception caused by a worm. Resection was resorted to, and Paul's tubes tied in. After four attempts the artificial anus was closed, and the patient recovered.

Dowd[5] records a recovery after resection of a gangrenous subacute invagination in a boy of $4\frac{1}{2}$ years, and Skevington[6] relates a successful resection for gangrene in a boy of 12.

The hope of the future lies not in successful resection, but in less frequent need of that operation, which must always have a very high mortality in these cases. In chronic or subacute cases in older patients recovery is not so rare.

The late Sir Frederick Wallis[7] recorded an interesting case of irreducible chronic intussusception of the small intestine, occurring in a woman. He resected forty-two inches of the bowel, and joined the ends by means of a Murphy's button, which he had to remove from the ileum about three and a half weeks later. The button used was too large, and therefore gave rise to symptoms of obstruction, but the patient recovered.

Sir Watson Cheyne records a successful case of resection of a chronic intussusception which was due to invagination of Meckel's diverticulum, and he refers to another case.[8]

Zum Busch[9] records a successful resection in a similar case in a young man, and he mentions a case of Hirschsprung in which spontaneous recovery occurred.

III. **Volvulus.** The intestine here is usually either twisted on its mesenteric axis, or bent at an angle. The first is the acuter condition, owing to the strangulation of vessels. It is usually met with in the sigmoid flexure, when this has a long narrow mesocolon, especially in adults who have been subject to constipation (Treves). The distension is usually enormous, the sigmoid appearing to occupy the whole abdomen. Fortunately the twisted loop often contains gas with only little fæcal matter; this is due to the obstruction of both ends of the loop, with partial obstruction of its blood-vessels. The author has had two patients,

[1] *Intercolonial Med. Journ. of Australasia*, August, November, and December, 1904.
[2] *New York Med. Journ.*, May 14, 1904.
[3] *Ann. of Surg.*, October 1900, p. 497. [4] *Lancet*, September 16, 1905.
[5] *Ann. of Surg.*, vol. xxxvi, 1902, p. 48. [6] *Lancet*, 1905, vol. xi, p. 890.
[7] *Lancet*, December 5, 1903. [8] *Ann. of Surg.*, vol. xl, 1904, p. 796.
[9] *Clin. Soc. Trans.*, vol. xxxvi, p. 213.

both old ladies, suffering from acute volvulus of the sigmoid. One of them is related in full. Brief notes of the other are also given, for they are instructive. Both recovered.

CASE I. VOLVULUS OF THE SIGMOID COLON.[1] A frail old lady, aged 81 years, a lifelong sufferer from chronic constipation, had during the last ten years several attacks of acute obstruction. These attacks generally passed off in a day or two, leaving the patient quite well again. About seven years ago the rectum prolapsed to a great extent and could not be reduced. The patient was in a very grave condition when Dr. C. C. Stead opened the abdomen and drew the bowel back and fixed it to the abdominal wall with a few sutures. Since then the patient has had the attacks of abdominal pain as before, and about three years ago she had a very severe one, during which a ventral hernia at the site of the operation was very tight. It was thought that an operation would be necessary, but fortunately the hernia was reduced, and the symptoms abated. For the last two years the patient has been a good deal better and able to enjoy life. I was called to see her on the afternoon of July 14, 1910.

History of Present Attack. Early in the afternoon of July 11 she was seized with severe abdominal pain a good deal worse than her usual attacks. The pain was difficult to locate, but it was mostly about the navel. The bowels had not been opened since in spite of numerous enemata and a variety of purges. She had not been sick once, and had taken very little food. The pain had been coming on in spasms and had been so severe that the patient could not sleep on the nights of the 11th, 12th, and 13th. The abdomen had become more and more distended. A long rectal tube, which she had been in the habit of passing, did not relieve her. Another doctor was called in in consultation. It was then decided to have a further consultation with a view to operation. When I saw her three days after the onset of the attack, the pulse was fairly good, 108 and regular, although it had intermitted earlier in the day, and some champagne had been given. The temperature was normal. The breathing was wheezy and 36 per minute, due to subacute bronchitis. The abdomen was enormously distended and tender in the lower part, especially towards the left. A very large coil could be seen extending obliquely across the lower part on the left side from the region of the hernia under the left rectus. At this spot there was a hard swelling. There was no dulness in the flanks and no tenderness in the upper part of the abdomen. Nothing abnormal could be felt from the rectum. An operation was advised.

Operation. This was performed at 7 P.M. under chloroform. A semicircular incision was made across the lower part of the abdomen towards the left side. The hernial sac was opened and showed omentum only. This was not strangulated. There was free serous fluid in the abdominal cavity. The opening was enlarged downwards through the left rectus, and a hugely distended coil of large intestine was discovered. This proved to be the sigmoid. On passing the hand downwards to the pelvis in search of a possible growth, the shortened ridges of a twisted mesocolon could be felt. The distended coil extended upwards and to the left, touching the liver and the right flank, and also occupying the right iliac fossa. A vain attempt was made to undo the twist without bringing the bowel out. A dense, short adhesion was found between the loop and the left edge of the hernial orifice. This was tied and divided. While bringing the bowel out, the distension of the projecting part increased so that the peritoneum began to crack, allowing the mucosa to project just like the inner tube of a bicycle. To prevent extensive rupture, a large cutting needle was at once thrust through a longitudinal band, with the result that a large amount of gas, but no fæces, escaped. The loop was then empty except for a few scybala. The small puncture was closed by a purse-string, reinforced by means of a Lembert suture. The bowel was untwisted, washed and replaced in the abdomen, care being taken to push the proximal limb of the loop as high up as possible. What had been taken to be the upper part of the loop proved to be the lower, when the bowel was traced down into the rectum, and the perforation which had been made near the adhesion was found to be near the upper part of the loop. The length of the twisted loop was about three feet, and its circumference was about fifteen inches. It consisted only of the sigmoid, the descending and transverse colon and the cæcum being almost natural, and the small intestine was very little, if at all, distended. The meso-sigmoid was of great length and infiltrated with blood. One and a half rotations of it had occurred. The muscular wall of the bowel was greatly hyper-

trophied, clearly showing that the condition had existed in an incomplete condition for a very long time. The peritoneal coat was inflamed and sticky, but no pus could be seen. The patient was so ill that there was no time to attempt to fix the bowel to the back wall of the abdomen. All that could be done was to place it in as good a position as possible, and then to bandage the abdomen very tightly. The parietal wound was rapidly closed. The operation lasted half an hour. The bowels were freely opened early next morning. The patient made a rapid recovery and remains well now four years after the operation.

CASE II. A lady, aged 61. Patient of Dr. Burgess. Six years ago the patient was operated upon for acute intestinal obstruction. After making an incision in the left linea semilunaris the surgeon accidentally opened a greatly distended colon. It made a noise like a bursting tyre, and discharged a large amount of gas and fæces. He tied a Paul's tube in at once, and the patient gradually recovered. Malignant structure of the sigmoid was diagnosed, and a bad prognosis was given, but after some weeks the bowels began to open naturally and there was a good deal of difficulty in keeping the colostomy wound open. After six months the fistula was allowed to close, and to everybody's surprise the patient made a complete recovery except for some weakness in the abdominal wall at the site of the colostomy. The bowels acted regularly with the aid of an occasional aperient. She has never had any more colic. She has never passed any blood or mucus. The abdomen, however, has ever since, and for some time previously, been somewhat distended. On February 27, 1912, it became more distended, and the patient had a good deal of pain in the lower part of the abdomen, especially on the left side. Since then the swelling has rapidly increased. All purgatives have failed to act, and enemata have also been ineffectual. A rectal tube could not be passed more than six inches. No growth could be felt. An enormously distended coil of intestine could be seen extending along the course of the transverse colon, above the umbilicus and down to the left flank. Dr. Hale White saw the patient on the afternoon of March 1 at six o'clock with Dr. Burgess, and advised an immediate operation. The pulse and temperature were normal, and the patient had not vomited. The writer saw her at 8 P.M. In view of the past history and the presence of the greatly distended coil a diagnosis of volvulus of the sigmoid was made and an operation was performed the same evening. Dr. Stamm gave A.C.E., and I opened the abdomen through the left linea semilunaris, keeping to the right of the colostomy hernia into which a distended loop of sigmoid projected. A very large coil of bowel was found occupying the pelvis, the left flank, and also the middle part of the abdomen extending almost to the liver. A hand was passed into the pelvis and a rotation of the sigmoid loop was made out. At the attachment of its mesentery radiating ridges were felt. The incision was enlarged and the loop was gradually delivered. The coil was longer and larger than a great coat sleeve. The twist could not be completely reduced owing to the great distension and extensive adhesions at the site of the colostomy. A trocar was thrust into the middle of the distended bowel, and a very large amount of gas at once escaped through the attached rubber tube ; a little fæces also came away. The opening was closed with a purse-string suture of thread as the cannula was withdrawn. An attempt was made to sever the attached piece of colon from the sac of the hernia. In doing this, however, a small opening was made into the thin bowel. It was therefore decided to tie a glass tube into this opening for temporary drainage only. A loop of bowel above this was placed vertically behind the abdominal incision, which was closed with mass salmon-gut sutures not perforating the peritoneum so that the bowel might get extensively attached to the parietes to prevent further rotation. The tube was removed a few days later and the patient made a good recovery, and was well three years later.

It is certain that the volvulus was not reduced at the first operation, but the drainage and shrinkage of the distended loop served to re-establish the channel after some weeks. Later on distension increased, and history repeated itself.

The next most common site is the cæcum. Occasionally the small intestine is the part involved. Ulceration leading to fatal peritonitis may set in either in the twisted loop or in distended bowel above the obstruction, especially in the cæcum when the sigmoid is obstructed.

Mr. Makins [1] believes that volvulus of the cæcum is far commoner than is generally considered, and he records a typical and interesting case :

[1] *Lancet*, vol. i, 1904, p. 156.

The patient was a woman, 67 years of age. During the last eighteen months she had been the subject of four or five distinct attacks of abdominal pain, accompanied by vomiting sufficiently severe to confine her to bed. Ten days prior to her admission to hospital she was seized with severe pain in the lower abdomen, most acute in the region of the umbilicus. Obstruction of the bowels had been complete for six days, vomiting had been frequent, and neither flatus nor fæces had been passed per rectum. On admission the woman looked anxious and ill ; vomiting of dark fæculent smelling fluid was frequent. Constipation was absolute. Her tongue was furred but not very dry. Her pulse-rate was 108, and her temperature was 97° F. Her abdomen was considerably distended ; the prominence was medium, and on inspection gave the impression of a tumour rising from the pelvis. It was resonant throughout except in the right flank.

An operation having been decided upon, the abdomen was opened through the right rectus from just above the level of the umbilicus downwards. A hugely ballooned piece of bowel was at once disclosed, occupying the whole field of operation. The incision was enlarged, but the distended gut could not be delivered, as it was tightly wedged into the pelvis. A trocar and cannula were therefore introduced, and a large quantity of gas and liquid fæces was evacuated. The slackening of the tumour thus produced allowed of the hand being inserted into the pelvis beneath the sac, and the piece of bowel was brought out. The intestine affected proved to be the cæcum and lower part of the ascending colon, which was provided with an unusually long mesentery. The twist was through half a circle, and involved the ascending colon about the centre of its length. The ileum remained viable. It was considered advisable completely to empty the loaded bowel, which was then readily replaced, the two punctures having been securely sutured. The patient made an uneventful recovery, the bowels acted spontaneously the day after the operation, and the stitches were removed from the abdominal wound on the eighth day. On the fourteenth day a localised collection of pus was evacuated from the lower part of the wound in the abdominal wall, and at the end of a month the patient left the hospital recovered.

Corner and Sargent [1] have collected and analysed fifty-seven cases, including their own. They lay stress on the fact that not all the cases are acute, but that chronic and subacute varieties exist. Before the final complete obstruction, many of the patients suffer from constipation and paroxysms of pain in the right iliac fossa, which may be mistaken for appendicular colic, because fever is absent. In some cases there is a history of a previous and milder attack of intestinal obstruction. The cæcum and the ascending colon may be unduly loose, and the mesentery of the ileum unduly long, with narrow attachment. Rotation may occur upon the root of the mesentery and the superior mesenteric artery, or upon the lower part of the mesenteric attachment, or upon the vertical axis of the cæcum and colon.

In the majority of cases the distended cæcum travels upwards and to the left behind the root of the mesentery, and may be found near the spleen ; in others it may lie in the lumbar region, or fall into the true pelvis.

Hilton Fagge in his classical paper on intestinal obstruction described two interesting subacute or chronic cases many years ago.[2]

In recent years, many surgeons have discovered this condition during an exploration for acute or subacute obstruction. It is curious that Mr. A. E. Barker states that he has not seen a case.[3] Sherren, Jonathan Hutchinson, Spencer, and others mentioned cases.[4] It is three times more common in males than females.

The following points are noteworthy in the diagnosis and treatment of volvulus. It is usual for the abdomen to become enormously distended in a short time, and for a hugely distended coil to be visible when

[1] *Ann. of Surg.*, 1905, vol. xli, p. 63. [2] *Guy's Hospital Reports*, vol. xiv.
[3] *Lancet*, vol. i, 1906, p. 599. [4] *Loc. supra cit.*

the abdomen is watched for peristalsis. It is not uncommon for this form of obstruction to follow an injury,[1] some loop of bowel distended with fæces, and with a long mesentery probably becoming suddenly displaced and unable to recover itself. It may follow an abdominal operation. The writer remembers and saw the operations upon such a case sixteen years ago. The first was for a ruptured left tubal pregnancy with grave hæmorrhage, the second was too late a few days later for a volvulus of the sigmoid, which had not been replaced in the pelvis at the end of a hurried operation. Again, this form of obstruction has been noticed, whether as a mere coincidence or not, in many cases in the insane. It is probably due to the prevalence of chronic constipation in these patients. Finally, at the time of treatment, Sir F. Treves's warning[2] must always be remembered: "The reduction of a volvulus does not usually remove the anatomical condition that led to it." The truth of this is shown by their tendency to recur.

Thus the late Mr. Greig Smith[3] described a case of volvulus of the small intestine which recurred a week after it had been untwisted by abdominal section. Enterotomy was then performed, and the patient for some time wore a catheter in the opening to allow of the passage of flatus into a bottle which he carried in his pocket. After some time the distended bowel had so contracted that the use of the catheter could be dispensed with. Dr. Finney reports[4] a case of volvulus which involved the whole colon between the ileo-cæcal valve and the sigmoid; it was rectified by operation, and recurred nearly three years later. A second recovery followed.

Whiting[5] relates two cases of volvulus of the whole of the jejunum and ileum. One of the patients, a boy of 5, was moribund at the time of the operation; the other, a man of 34, recovered.

Tully Vaughan[6] has collected twenty-one cases of volvulus of the small intestines; seven of these were submitted to operation, and fourteen recovered. In several cases, the difficulties were so great and the appearances so puzzling, that the operators did not recognise the condition during the operation.

J. B. Roberts[7] records a case of volvulus of a part of the ileum complicating typhoid fever; the patient recovered. He also refers to two other cases, in which the lesion was only discovered at the autopsy (Eustis). In another case, volvulus followed cœliotomy for a perforated typhoid ulcer; the patient recovered from the two operations.

Magruder[8] discusses volvulus and records a successful case of resection of a volvulus of the ileum in a patient aged 25.

F. T. Stewart[9] records one case and presents an analysis of eight other cases of volvulus of the great omentum, but in none of these was intestinal obstruction diagnosed. In five of them the omentum was connected with a hernia, and a diagnosis of strangulated hernia was arrived at in two of these. Four of the patients were thought to be suffering from appendicitis.

Treatment. A free incision will be required here, so as to enable the surgeon to get at the root of the volvulus. The volvulus may present at

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[1] See cases mentioned by Mr. Turner, Dr. F. Hawkins, and Mr. Stavely (*Lancet*, vol. ii, 1892, p. 995); a case successfully operated on by Mr. Silcock (*Clin. Soc. Trans.*, vol. xxviii, p. 180). References are made in the latter paper to eight successful cases operated on abroad.

[2] *Oper. Surg.*, vol. ii, p. 390.   [3] *Abdom. Surg.*, p. 450.

[4] *Johns Hopkins Hosp. Bull.*, March 1893.

[5] *Ann. of Surg.*, vol. xxxix, p. 1036.   [6] *Journ. Amer. Med. Assoc.*, May 1903.

[7] *Ann. of Surg.*, 1906, vol. xi, p. 242.   [8] *Surg. Gyn. and Obst.*, December 1911.

[9] *Journ. Amer. Med. Assoc.*, March 19, 1904.

once as a hugely distended coil; or its twisted base may simulate a band, and a band may actually complicate the case, as when a vermiform appendix is coiled round the root of the twist of the volvulus.[1] If attempts at reduction fail, the volvulus should be emptied with a trocar and cannula with rubber tube attached near the summit of the loop brought outside the abdomen if possible and surrounded with gauze packing. When the loop has been emptied as far as possible and the perforation closed with a purse-string suture, further attempts at reduction should be made, and they will generally succeed. The coil should be fixed to the parietes to prevent recurrence of the trouble. This is best done by suturing the loop and its mesentery to the postero-lateral wall of the abdomen. Care must be taken not to insert sutures near the course of the ureter or the iliac vessels or other structures of importance on the posterior wall. No potential hernial cavity or orifice must be made by leaving a gap or fossa between the loop and the parietal peritoneum. Shortening of the mesocolon, as advocated by Prof. Senn, is not to be recommended, for gangrene of the loop may follow this proceeding.

Mr. Maunsell's method of fixing the reduced cæcum by performing appendicostomy has much to recommend it, for not only is the cæcum drained of its poisonous products for as long as may be thought desirable, but the fistula can be closed practically without risk at any time (see p. 269). Plication of the cæcum has been adopted to lessen the size of the viscus and prevent recurrence;[2] but judging by the temporary nature of the results of gastroplication, this does not seem to be a very reliable way of preventing recurrence.

In some cases, small gangrenous areas or grey thin lines may be seen; and these may be inverted, as recommended by Makins.[3] In other cases the damaged loop may be temporarily drained with great advantage, for this allows the dilated intestine to shrink and regain its tone. Further, by fixing the distended loop, it tends to prevent recurrence. In some sigmoid cases colostomy may be avoided and early recurrence may be prevented by passing a long rectal tube through the anus and well into the dilated bowel before the abdomen is closed. If the loop is gangrenous, it should be resected as rapidly as may be, and after the contents of the bowel above the obstruction have been evacuated end to end anastomosis should be performed by direct suture. In some cases Paul's tubes are tied in temporarily, the anastomosis being deferred.

If the volvulus be merely irreducible, a temporary artificial anus may be made above the twisted loop, which has been first completely emptied and securely closed. Although this plan may be successful in some cases, it should not be resorted to until every reasonable effort has been made to untwist the coil, or in patients who are *in extremis*. In some cases, where the volvulus is persistent, recurrent, or irreducible, or where a fæcal fistula persists, excision of the twisted loop is the best treatment.

Lateral anastomosis of the extremities of the loop, as advised by Braun may be suitable for some cases. Anastomosis between the ileum and the descending loop of the sigmoid may be of service in some rare and irreducible cases.

[1] *Brit. Med. Journ.*, vol. ii, 1892, p. 170.
[2] Corner and Sargent, *loc. cit.*
[3] *Clin. Soc. Trans.*, vol. xxxvi, p. 183.

Mr. Sherren [1] has recorded a brilliantly successful resection of a gangrenous volvulus of the cæcum, followed by immediate and direct end-to-end anastomosis of the ileum and ascending colon. Sir Arbuthnot Lane has successfully resected an enormously distended gangrenous volvulus of the sigmoid flexure.

Sir Berkeley Moynihan [2] records several interesting examples of volvulus, especially Case 4, where a recurrent volvulus of the sigmoid was successfully resected. He also relates a case of *compound volvulus* of the ileum and sigmoid in which the two loops had intertwined.

The mortality of volvulus is very high. Thus in Corner and Sargent's collection of fifty-seven cases, nineteen recovered and twenty-one died after operation ; the remainder died without operation. This gives a mortality of 52·5 per cent. for the operation, but it should be pointed out that these statistics range over a good many years, and that future results may be expected to be better. Earlier recognition and earlier exploration in all cases of reasonable doubt will do much towards attaining this end. But of the six cases that formed the basis of Corner and Sargent's paper only one recovered, although five at least of the operations were performed since 1902. Quick and efficient work, evacuation of the distended loop, and of the intestines above the obstruction are also important elements in the success of the operation.

IV. **Gallstones, Intestinal Calculi, &c.** Gallstones, the most common of these, present cases very favourable for operation if taken in time, owing to the simplicity of the cause of obstruction, and the facility with which it may be usually dealt with. Operation has been here too often deferred, owing to the fact that these patients, usually advanced in life and stout, are not well suited to operation from a general point of view, and especially because the final attack of intestinal obstruction is mistaken for a severe bout of biliary colic, with which the patient and his medical attendant are generally too familiar. Occasionally the stone passes and spontaneous recovery ensues. The faint hope of this happy issue has unfortunately accounted for many deaths from delay. Sir F. Treves [3] states that of twenty cases in which gallstones " produced definite and severe symptoms of obstruction " six patients recovered by the spontaneous passage of the stone, and fourteen died unrelieved.

In some cases, in addition to the age, sex, obesity, and habits of the patient, the history of previous inflammation in the neighbourhood of the gall-bladder may help the diagnosis. More than two-thirds of the patients are females, and the great majority are over 40 years of age. In four cases, certainly, the calculus has been felt—the abdomen being undistended—before operation. But in the majority it is probable that here, as elsewhere, operation alone will demonstrate the cause of the obstruction. Although a gallstone, after ulcerating from the gall-bladder into the duodenum, may become arrested anywhere in the small intestine, it commonly gets impacted near the lower end of the ileum where the bowel is narrowest. A stone having ulcerated directly from the gall-bladder into the colon may get arrested in the narrow sigmoid colon.

The following courses may be adopted : (1) Try to pass on the stone through the ileo-cæcal valve into the large intestine. Mr. Clutton [4]

[1] *Lancet*, vol. i, 1906, p. 599.   [2] *Abdominal Operations*, p. 492.
[3] *Intest. Obstruct.*, p. 335.   [4] *Clin. Soc. Trans.*, vol. xxi p. 99.

succeeded in doing this, the stone being situated eight inches above the valve.   But usually the stone is too firmly fixed.

Mr. Clutton's case is a very instructive one.   The patient, a woman aged 70, was operated upon within twenty-four hours of the beginning of the attack.   Fifteen months before she had passed a large faceted biliary calculus, and after her recovery from this had had a swelling in the region of the gall-bladder.   This disappeared with the onset of the obstruction.   A median incision four inches long having been made, the stone was readily felt, and though it tightly fitted the lumen of the intestine it could be forced along.   As, owing to the early date at which the operation was performed, there was no marked difference between the intestine above and below the obstruction, the site of the ileo-cæcal valve was determined by making out the cæcum and the appendix.   There was not much difficulty in urging the calculus in the right direction, but as soon as the valve was reached some considerable force was required to make it pass through.   This most successful case strongly supports Mr. Clutton's advocacy of an early operation.

(2) If the stone cannot be pushed onwards, and if it is too hard to be broken up by gentle pressure with the finger, it must be removed. The loop of bowel containing the calculus is drawn well outside the abdominal cavity surrounded with gauze packs, and the stone is displaced upwards into more healthy intestine if possible.   An assistant fixes the stone by compressing the bowel above and below it, while the surgeon removes it through a longitudinal incision made along the free border of the intestine.   Care is taken not to lacerate or bruise the edges of the wound by trying to extract the stone through an incision which is too small.   If the intestine above the obstruction is distended, its toxic contents must be evacuated through the incision, care being taken to hold the latter over a basin well away from the wound.   The intestine is then thoroughly cleansed, and the incision closed transversely with two continuous sutures of fine linen thread.

(3) If the bowel at or just above the stone be gangrenous, it should be resected, and an anastomosis performed immediately after emptying the distended intestine above.   If the condition be doubtful, any small grey area may be inverted, and the intestine returned just within the abdomen, or the loop may be resected.   (4) In some grave cases an enterostomy tube of comparatively small calibre may be temporarily tied in, the opening being inverted after two or three days.

Immediate resection is far preferable to the formation of an artificial anus if the condition of the patient is good enough to allow this.

Mr. S. M. Smith[1] relates a fatal case of obstruction of the sigmoid flexure by a gallstone which had entered the transverse colon from the gall-bladder ; the stone was not discovered at the operation.

Mr. Milward records a similar case, in which he successfully removed a large stone from the sigmoid.[2]

Dr. Le Conte[3] had to resect a piece of gangrenous small intestine above the stone, which had been forced along by purgatives after it had caused injury and infection of the bowel and its mesentery at the site of its original impaction.   End to end anastomosis was performed at once, but the patient died.

Prognosis.   From the deceptive nature of the symptoms and often from the incompleteness of the obstruction, delay in exploring is far too common, and the septic contents of the obstructed bowel are often not removed.   It is not surprising therefore that the operation is attended

[1] *Lancet,* vol. ii, 1905, p. 1174.   [2] *Loc. cit.,* p. 1327.
[3] *Ann. of Surg.,* 1902, vol. xxxvi, p. 300.

by a high mortality. In Barnard's eight cases [1] the mortality was 57 per cent., in Courvoisier's 125 cases it was 44 per cent., and of Schneller's eighty-two cases 56 per cent. died. In Eve's twenty collected cases the mortality was 40 per cent.

V. **Embolism and Thrombosis of the Mesenteric Vessels or of the Abdominal Aorta.** Mention must be made of the above conditions, as it is clear, from the cases published, that, though rare, they may simulate acute intestinal obstruction very closely. The explanation appears to be that a loop of intestine, deprived of its blood-supply by an embolus or thrombus, will functionally be as completely paralysed as if it had been strangled. Instructive cases of this kind will be found published by Mr. M'Carthy [2] and Dr. Munro, of Middlesbrough. [3]

Dr. Munro quotes from Gerhardt and Kussmaul the following diagnostic points of these cases : (1) A source of origin for the embolus; (2) profuse hæmorrhage from the bowels ; (3) severe colic-like pains in the abdomen ; (4) rapid reduction of temperature ; (5) demonstration of an embolus in some of the other arteries; (6) palpation of infarct in the mesenteries. In Dr. Munro's case, one of these, situated in the mesosigmoid, could be felt, before operation, in the left iliac fossa. To these points might be added advanced age and no evidence of malignant disease. The mischief is usually too extensive to admit of surgical interference. If it be limited to the small intestine, several branches are usually plugged. Complete obstruction with the usual symptoms and much distension develop later on.

The recorded cases have almost always ended fatally. In several cases, however, the portions of bowel and mesentery involved were removed with success.

Tyson and Linington [4] report a case of resection of about a foot of gangrenous small intestine, the condition being due to atheromatous embolism of a branch of the superior mesenteric artery in a woman 66 years of age. Considerable difficulty was experienced in getting the stitches to hold in the sodden and friable mesentery, and the patient died.

Jackson, Porter, and Quinby [5] have collected and analysed 214 cases of embolism and thrombosis of the mesenteric vessels.

They found that blood was passed per anum in only 41 per cent. of the cases. In forty-seven cases operations had been performed, with four recoveries, or a mortality of 92 per cent.

A review of the pathological appearances indicated that in about fifteen of the cases which had not been submitted to operation short resections might have been performed with advantage.

Elliot [6] describes an interesting case of thrombosis of a part of the superior mesenteric vein leading to gangrene of a loop of jejunum fourteen inches long ; this was successfully resected. The thrombosis came on eighteen days after anterior gastro-jejunostomy. In these cases the only hope is in early operation and resection well beyond the disease.

[1] *Ann. of Surg.*, vol. xxxvi, 1902, p. 161.
[2] *Lancet*, vol. i, 1890, p. 646.
[3] *Ibid.*, vol. i, 1894, p. 147.
[4] *Clin. Soc. Trans.*, vol. xxxv, p. 114.
[5] *Journ. Amer. Med. Assoc.*, June 4, July 1904.
[6] *Ann. of Surg.*, 1905, vol. xlii, p. 674.

CHAPTER XXI

INTESTINAL ANASTOMOSIS AND EXCLUSION
CLOSURE OF FÆCAL FISTULA AND ARTIFICIAL ANUS

INTESTINAL ANASTOMOSIS AND EXCLUSION

THESE operations, which are now in common use and of great value in suitable cases, we owe to the originality of Maisoneuve and the laborious experiments of Senn. Their elaboration is largely due to the work of Hartmann, Mikulicz, Salzer, Monprofit, Arbuthnot Lane, and others.

Simple Lateral Anastomosis. Here a communication or short circuit is made between the bowel above and below an obstruction or disease,
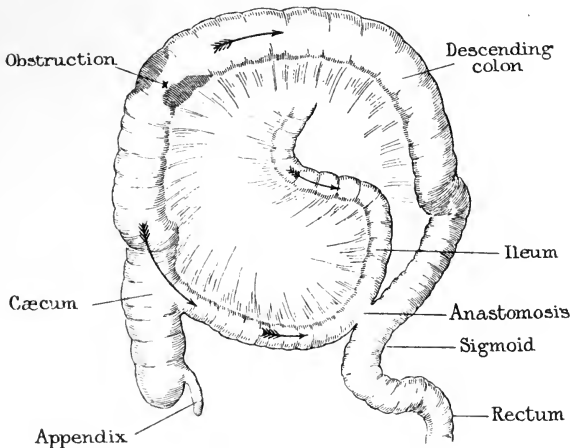
FIG. 186. Lateral anastomosis. Ileo-colostomy.

but apart from complete obstruction, which is rarely permanent, some of the fæces can still pass through the diseased part, for the bowel is not divided or occluded. In the absence of obstruction the side track tends to close, unless very large, for peristalsis directs most of the contents along the natural passages (see Fig. 186).

Indications. (1) *Chronic obstruction due to growth* either as (*a*) a permanent measure in preference to colostomy when the growth is irremovable, or (*b*) a preliminary step to resection of the growth.

An old man with incurable growth of the splenic flexure with peritoneal nodules lived over a year after an anastomosis was made between the transverse and pelvic colons, during acute upon chronic obstruction. The patient was very comfortable and able to continue his important work for nearly a year. He ultimately died almost painlessly of metastases in the liver. In a number of cases I have short-circuited similar growths at different parts of the colon. With a growth at the

hepatic flexure experience shows that a lateral ileo-colostomy does not relieve the patient so much as an anastomosis between the cæcum and transverse colon, for some of the contents of the small intestine still continue to pass into the distended cæcum. This difficulty can be met in another way by narrowing or dividing the ileum below an ileo-colostomy.

(2) *Chronic obstruction due to other causes* such as fibrous structures, tuberculosis or other disease of the mesentery, or matting and kinking of the intestine due to inflammatory affections.

(3) *Recurring volvulus*, especially of the pelvic colon. The limbs of the loop have been anastomosed, and similarly Gant has joined the pelvic colon to the front wall of the rectum for kinking at the lower end of the pelvic colon. It is probable that many troublesome cases of constipation, including the so-called congenital dilatation of the colon, may be successfully treated in this way.

(4) *Gangrenous bowel.* The healthy limbs of a doubtful or gangrenous loop have been anastomosed, while the loop has been drained and left in a hernial sac.

(5) Entero-anastomosis has been performed to prevent or cure lateral *regurgitant vomiting*, and has been discussed under gastro-jejunostomy.

(6) Lateral anastomosis has been used as a preliminary step to closing a fæcal fistula or artificial anus, but it is not so effective as unilateral exclusion, which immediately stops leakage.

Operation. The anastomosis is made as already described at p. 292. Direct suture is by far the best means of union. Here it is well to remember that :

(1) The parts to be joined should be as healthy as possible and especially as regards their serous surfaces.

(2) There should be no tension upon the sutures, therefore only such parts should be joined as can be easily approximated with or without mobilisation.

(3) The anastomosis should be made at a suitable distance from the obstruction or disease. For instance, it should not be so near that the new opening is likely to be invaded by the growth which calls for the anastomosis. And it should not be so far from the obstruction as to throw an unnecessary length of intestine out of action for stasis and putrefaction to take place.

(4) In all cases the tendency to contraction of the new aperture should be remembered and the latter should be made at least three inches long. It should be made especially large when joining two parts of the colon ; when the contents are solid and peristalsis is poor.

(5) Whenever possible the parts should be joined together in an iso-peristaltic manner ; and in any case care should be taken to avoid kinking by joining the intestines for some distance above the anastomosis.

(6) Care must be taken by suturing the mesenteries to avoid making bands, apertures or other possible sources of future intestinal obstruction.

Exclusion. Simple lateral anastomosis is not enough in some cases, for it is often desirable to " exclude " a portion of diseased intestine, so that no fæces can reach it to be retained or cause irritation. Thus in colitis it is desirable to give the diseased part complete rest. The same is true of some cases of tuberculous and malignant disease of the bowel and chronic obstruction of the colon, due to other causes. Nothing short of complete division of the ileum will prevent accumulation of fæces above the obstruction. But in the absence of mechanical obstruction it has

been found that the loss of a flushing stream has led to troublesome accumulation in the cæcum after complete division of the ileum in ileo-sigmoidostomy. The accumulation is partly the dried secretion of the large bowel, but chiefly fæces regurgitated from the pelvic colon.

In many cases, this has made it necessary to remove the excluded part of the bowel or to perform appendicostomy.

The anastomotic opening is not so likely to close when no alternative passage is left.

Unilateral Exclusion involves complete division of the intestine at one point above the disease, with anastomosis or implantation of the proximal end into the side of the healthy intestine below ; the distant extremity may be either closed or drained according to the necessity. It is generally closed. For example, the ileum is often divided six inches from the
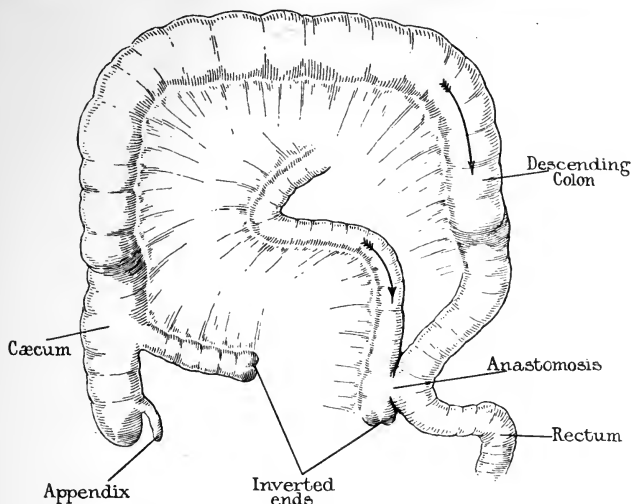
FIG. 187. Unilateral exclusion. The ileum has been cut across, its end inverted, and the proximal part anastomosed to the pelvic colon. End-to-side union is better.

cæcum, and the upper segment joined to the colon below an incomplete obstruction, while the distal end is closed (*see* Fig. 187).

Indication. (1) *Artificial anus* especially in the small intestine, where it is vital to prevent leakage with certainty and without delay. The bowel is divided just above the opening and implanted into the side of the bowel at least six inches below the artificial anus. When the patient is better the excluded portions of bowel can be removed if necessary on account of mucous discharge or prolapse.

This method is particularly valuable and final when the upper end of the lower segment of bowel has been closed already.

(2) *Fæcal fistula* especially when suppuration continues.

(3) *Colitis.* The ileum is divided or occluded and joined to the pelvic colon, but unfortunately the pelvic colon itself is rarely healthy in these cases, so that complete relief is not often likely.

Apart from this, however, the method appears more desirable than colostomy, especially from the point of view of cleanliness. The need of a second operation for closing an artificial anus is also avoided. When

the pelvic colon is healthy unilateral exclusion is obviously much better than colostomy.

Regurgitation of fæces into the excluded bowel can be lessened or even prevented by exaggerating the natural kink at the junction of the iliac and pelvic colon. In some cases appendicostomy may be performed at the same time, so that the cæcum and colon can be flushed if necessary.

Five years ago I performed this operation on an elderly lady, who had a long tubular stricture extending from the splenic flexure to the lower part of the pelvic colon probably due to diverticulitis. The ileum was joined to the front of the rectum, and this gave great relief. The patient is still alive and fairly well.

(4) Unilateral exclusion has been performed for obstruction due to *irremovable growth of the colon*, but this is open to the serious objection
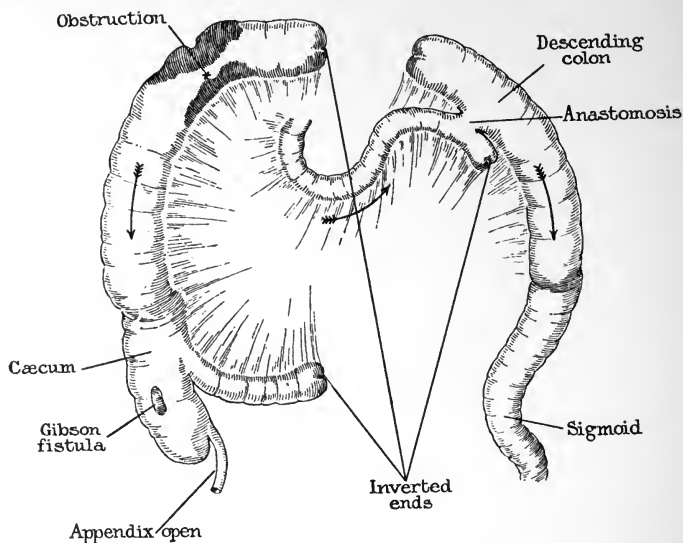
Fig. 188. Bilateral exclusion. The excluded loop must be drained through the distal end or through a cæcal or appendical fistula.

that intestinal secretions and discharges from the growth may accumulate in the excluded intestine, leading to distension, inflammation and even perforation. For this reason simple lateral anastomosis is preferable in these cases and further it is easier and takes less time—a point of considerable importance in cases of intestinal obstruction.

(5) *Tuberculous disease*, especially of the ileo-cæcal region, when the patient is too ill for resection.

(6) *Chronic Constipation.* This is fully discussed in chap. xxii. Sir Arbuthnot Lane's operation of ileo-colostomy, p. 402, may be taken as a good example of the technique to be pursued in these operations. He and others have found that end to side union is better than side to side, for with the latter method distension of the blinded extremity is apt to occur with pain and other troublesome consequences.

Bilateral Exclusion involves two divisions of the intestine, one above and one below the disease, the proximal and distal ends being joined together to reestablish the channel. The ends of the excluded loop are inverted or drained at one or both extremities. The distal extremity is

the best to choose for drainage, because peristalsis will help.   In case of obstruction, however, the fistula should be proximal to the obstruction. Appendicostomy or valvular cæcostomy may serve to drain an excluded cæcum.   Without adequate drainage the excluded bowel is a source of trouble and even danger, for it distends with mucus or pus and may perforate and cause peritonitis (*see* Figs. 188 and 189).

For this reason bilateral exclusion is rarely desirable.   As a rule, it is better to remove than to leave an excluded piece of bowel.   But the method is valuable in curing some cases of fistula between different parts of the intestine, or between the bowel and another cavity such as the vagina. In some of these it is easier and safer to exclude a small length of intestine, than to separate it at the fistula.   Then the excluded loop is drained through the old fistula and it soon withers.   Good examples are intestino-vaginal fistula, with matting in the pelvis, and gastro-jejuno-colic fistula
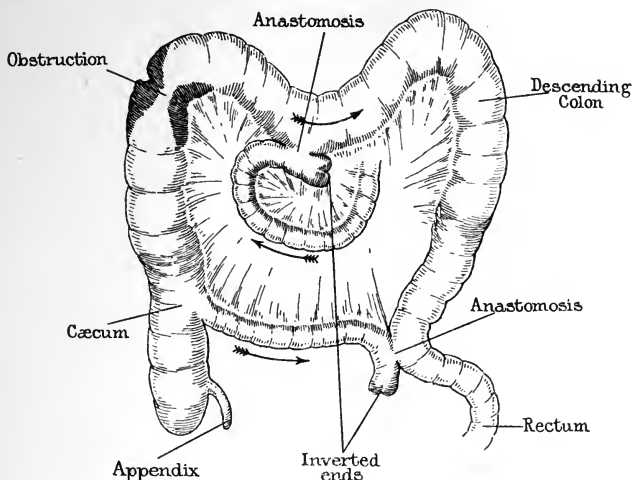
FIG. 189. Exclusion with drainage.   It is better to make end-to-side anastomoses.

high in the left flank with extensive adhesions.   It is possible that it may also be valuable for intestino-vesical fistula, but unless the aperture into the bladder is valvular, stone may develop in the pouch left in communication with the bladder.

Summer gives the following example of Monprofit's method.   With an obstruction by growth in the ascending colon the ileum is divided and its proximal end joined to the pelvic colon, and its distal or cæcal extremity implanted into the side of the transverse colon.   Clinical experience has shown that the ileo-cæcal valve does not prevent the passage of the contents of the distended cæcum into the ileum, and then into the colon below the growth and anastomosis.   Summer speaks well of this method but he suggests an improvement.   The ileum is not divided but approximated to the pelvic colon, and two anastomotic openings made, and between these openings the ileum is closed by a purse-string suture encircling it.   The aperture between the ileum and the sigmoid is closed to prevent the possibility of strangulation of a loop of bowel (*see* Fig. 190).

This method diverts *all* the contents of the ileum into the pelvic colon, and also provides a safety-valve for the cæcum.   As a matter of experi-

ence, however, the need of a double anastomosis is not apparent, for the contents of the cæcum drain either through the stricture, which is rarely complete, or through the ileo-cæcal valve. The most essential things are (1) a very large anastomotic opening and (2) the introduction of a tube through the anus and anastomosis into the ileum above the anastomosis. This remains in situ for four or five days and prevents kinking, and also promotes the free discharge of gas and other contents of the ileum during the critical early days after the operation.

Lance[1] has collected the records of seventy-six cases of bilateral exclusion performed upon the human subject. In eight of these the operation was undertaken for the treatment of fæcal fistula following operation for strangulated hernia. All the patients recovered, but in three of them the fistulous loop was afterwards excised. The remaining exclusions were for growth, chronic intussusception, tuberculosis of the large intestine,
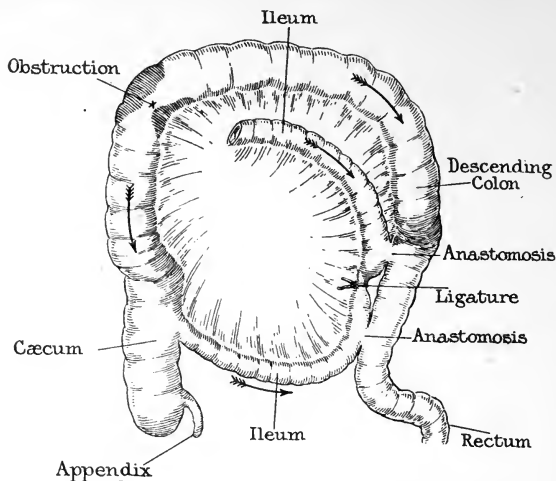
Fig. 190. Exclusion with drainage as suggested by Summer.

entero-vaginal fistula, &c. "In no case was there any ill effect attributable directly to the method." As a rule when a fistula from the excluded loop was not already present the two ends of the intestine were brought to the skin and sutured there. This procedure is sometimes known as "Hochenegg's method" of exclusion. The pre-existing fistulæ closed "in all the cases except those in which malignant disease was present. As a rule only one end of the loop remained permanently open, the other gradually dwindling in size, and eventually becoming quite closed" (Moynihan).

Prognosis. The immediate danger of lateral anastomosis is now very small; but the infective nature of the contents of the intestine still maintains the mortality above that of gastro-jejunostomy. The general condition of the patients requiring the operation is also poor. Above all, when it is performed as it often has to be for the relief of more or less complete intestinal obstruction, the distended œdematous and congested intestine is not favourable for firm union, so that leakage with peritonitis is not uncommon under the circumstances. Moreover, unless a long tube is passed through the anastomosis or unless the cases are properly selected,

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[1] *Thèse de Paris*, 1903, No. 348; quoted by Moynihan, *Lancet*, vol. ii, 1904, p. 1012.

paralytic distension may not be relieved by the operation.   It requires considerable judgment to decide when to choose colostomy or enterostomy in preference to lateral anastomosis.   A beginner will be wise to err on the side of caution, and to make an artificial anus if the obstruction is severe or has lasted some time.

As a rule exclusion is more difficult and more dangerous than simple anastomosis.
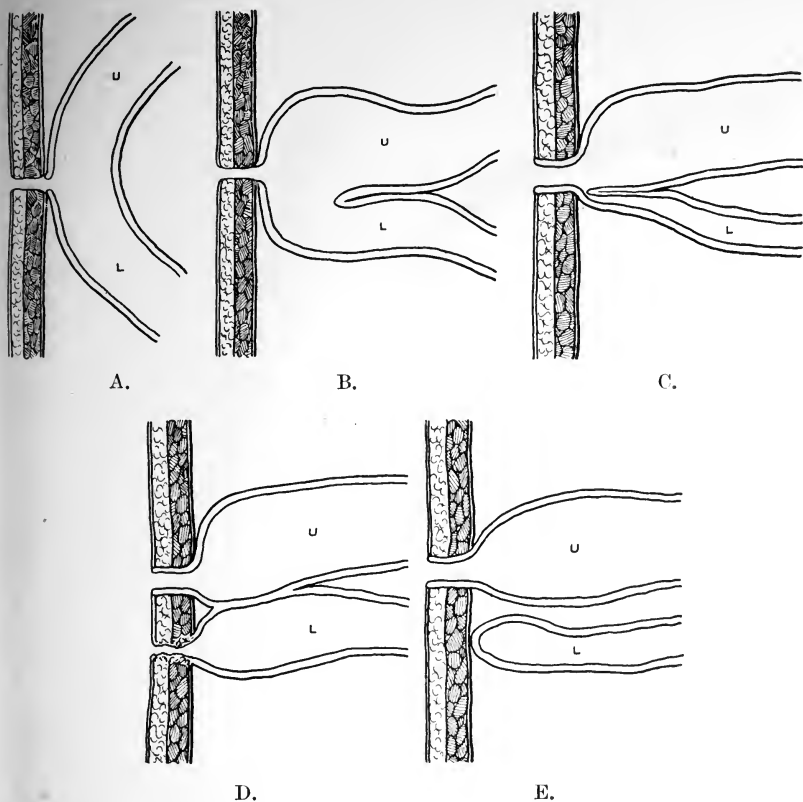
Fig. 191.   u, Upper.   l, Lower bowel.   A, fæcal fistula without kinking or spur formation.   The opening is usually small.   B, There are kinking and spurring.   C, Artificial anus with valvular spur.   D, Artificial anus.   The upper and lower bowels open separately on the skin.   E, Artificial anus, here the lower bowel is closed.

CLOSURE OF FÆCAL FISTULA AND ARTIFICIAL ANUS

Only some of the fæces are discharged through a fistula, but all issue from an artificial anus, none passing through the natural orifice.   Fig. 191 shows some of the points of difference and some of the varieties of unnatural openings.   A fistula is not always on the surface but may communicate between the bowel and a hollow viscus.   It may be congenital or acquired through injury, operation, gangrene, suppuration, tuberculous or malignant disease.

Before operating certain points of much practical importance should be considered, and first how far any spur or septum is developed.   The more

marked this is the less is the chance of closing the opening by any slight plastic operation such as paring and suturing the edges of the opening. The spur being left behind the fæces will make their way out again near the sutures, and the longer this condition is allowed to remain the more, of necessity, will the lower segment of intestine atrophy, and the more marked will be the difference between the two parts of the bowel.

It is of vital importance to know if there is any obstruction below, for if there is the hope of spontaneous cure is remote, and the prospects of a simple plastic operation are very poor. The presence of pus in the fistula is a strong contraindication to any immediate plastic operation ; it is better either to wait a little longer or to use indirect treatment by short-circuiting or occlusion. Other important points are the nutrition of the patient and the condition of the area surrounding the wound. The higher the fistula is situated in the small intestine the more will the nutrition have suffered and the more urgent the need for an early and radical operation for closing the fistula.

If given time small fæcal fistulæ, when the mucosa is not attached to the skin, usually close spontaneously, especially if the fistulous track is long and lined with granulations, but the higher the fistula the more liquid and irritating the discharges, and the less clear the channel below it, the less likely is it to heal. Fistulæ of the colon often close, and even a complete artificial anus with a spur may sink in and close spontaneously. Formerly the cautery was used to freshen the edges of callous fistulæ, and sometimes this led to healing by granulation.

A. Operations for Fæcal Fistula. (i) *Early operation.* Sometimes a fistula may be closed quite easily within a few days of its formation for temporarily draining the intestine for intestinal obstruction or late peritonitis. This can be done under local anæsthesia if necessary. The great advantages of operating as soon as possible are not fully appreciated. No dense adhesions have formed, no serious changes have taken place in the bowel near or below the fistula, and the parietal wound has not contracted. On several occasions I have successfully sutured and replaced the drained loop of small intestine within two days of the formation of the fistula, for the relief of late intestinal obstruction. It is important to replace the sutured part amongst supporting coils of small intestine, which soon become adherent to it and prevent further leakage.

The opening, if small, is closed with a piercing purse-string suture of fine linen thread and this is supported by a serous suture of the same material ; if of considerable size two sutures are passed as usual, the deep one being a Connell and the serous one a Cushing. The suture-line is transverse to the axis of the bowel. The parietal wound is almost completely closed, usually with interrupted piercing sutures of fishing gut. No drain is placed near the sutured bowel.

(ii) *Extra peritoneal operation.* In all these later operations it is most important to empty the bowel above and below the fistula, and to feed the patient on a diet leaving little residue for two days before the operation. The skin should be made as healthy as possible by dressing with suitable protective ointments, or the application of a fenestrated rubber apron fixed near the edges of the fistula with rubber solution, or the introduction of an effective tube to conduct the discharges away.

Extra peritoneal operations often failed especially when the fistula was in the small intestine, partly because the separation of the edges was not free enough owing to the operator's dread of opening the peritoneum,

and chiefly because serous surfaces could not be apposed. Grieg Smith tried to get over these difficulties by wider dissections. An elliptical incision is made passing near the margins of the fistula and continued upwards and downwards for about two inches. The edges of the fistula are thoroughly separated and securely sewn together to prevent leakage during the following stages. The extremities of the incision are deepened until the extra-peritoneal fat is reached, and the parietal peritoneum is separated from the abdominal wall all round the fistula for at least two inches (*see* Fig. 192). This step will be best carried out by commencing the separation at the extremities of the incision which are most remote from the fistula, and working towards the latter. In this way the proper layer is more easily and safely found. The bowel with the loosened peritoneum can now be lifted out through the incision in the parietes. If there is any difficulty in doing this a little
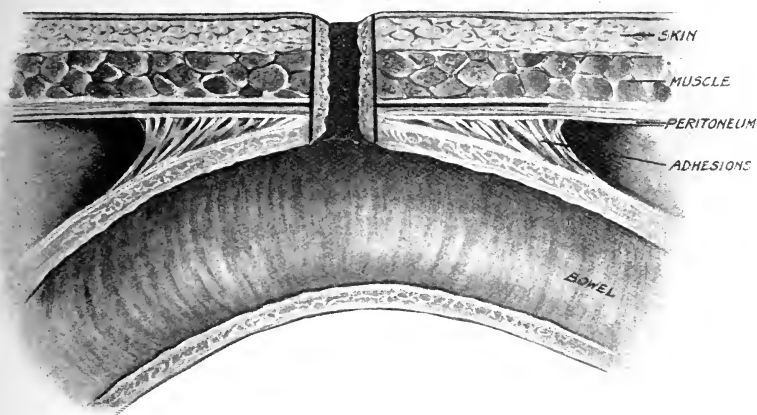
FIG. 192. Extra-peritoneal closure of fæcal fistula. The horizontal lines show the course of the incisions which mobilise the parietal peritoneum.

more detachment will make it easy. The fistulous track is now cut away down to the level of the bowel and the opening in the latter is closed with continuous Connell and Cushing sutures of fine linen thread. The line of suture must be transverse to the axis of the bowel so that the lumen of the latter is not narrowed. This is especially important when the opening is a large one (*see* Fig. 193). The intestine and peritoneum are now replaced and the parietal incision closed. This method may fail from want of removal of unhealthy tissues around the fistula. Moreover, the extra-peritoneal fat and the fibrous external surface of the parietal peritoneum are poor substitutes for serous surfaces which unite more quickly and more securely. Narrowing of the lumen, either from kinking, pre-existing spur or improper inversion, may also defeat the object of the operation. When any doubt exists it is better to open the peritoneum freely, so that serous surfaces can be apposed, the bowel thoroughly examined and also clamped to prevent leakage.

(iii) *Intra-peritoneal closure without axial resection.* The preparation and preliminary steps are the same. The fistula having been securely sewn the incision above and below it is deepened and the peritoneum opened well away from the fistula. The parietal incision is carried towards and around the fistula until the bowel is free. Care is taken as

the fistula is approached on account of adhesions to neighbouring coils, which may be flat, kinked and difficult to avoid. The bowel and mesentery are examined to decide whether a partial paring or complete axial resection is the most suitable. If a satisfactory local operation can be done it should be chosen, for it is safer than axial resection. On the other hand, if healthy serous surfaces are difficult to obtain without excising a considerable area of the bowel wall, so that kinking or spurring is likely to occur when the large wound thus made is closed, it is better to resect. Sometimes a definite stricture below the fistula has to be excised. When paring is adopted the affected loop is brought out and packed off with care. Its contents are squeezed up and clamps are applied. The suture is removed and the edges of the opening are pared, the incision being made through healthy tissues with a good serous surface. The margins are picked up with two tissue forceps which serve to make the

Fig. 193. Extra-peritoneal closure of fæcal fistula. Two layers of suture are shown closing the bowel.

wound transverse to the axis of the bowel. Two continuous sutures of fine thread are inserted. The first is a Connell suture and its knots are placed within the lumen of the bowel. The second is a Cushing serous suture, which buries itself better than a Lembert. In this way, narrowing of the channel is avoided (see Fig. 194). With small openings, especially in the large intestine, there is no need to make the suture line transverse. If the opening is a very long one sewing it up in the transverse direction may lead to kinking and excessive tension upon the sutures. The surface is cleaned with moist swabs, the packs are removed and the coil is returned to the abdomen, if possible well away from the wound and amongst other coils. If this is not practicable as in the large intestine, the omentum or appendices epiploicæ are brought over the suture line. Whenever possible the parietal wound is closed in layers, so as to prevent the formation of ventral hernia. In 1895 Mr. Jacobson [1] very successfully adopted this method in a case of fæcal fistula following sloughing due to intestinal obstruction by a band.

(iv) *Closure by complete resection.* This is sometimes necessary for fæcal fistula, and far more frequently for artificial anus. Mr. Makins

[1] The 5th edition of this work, vol. ii, p. 418.

performed the first successful operation of this kind in England in 1881.[1]
The skill with which the operation was performed was only equalled by
the thoughtfulness with which it was planned.

The first steps of the operation are the same as already described,
and the details of resection and union have been described in chap. xx.
Axial union is, as a rule, the best, but when there is any difficulty one of
the other methods may be adopted.

(v) In certain cases the methods already described may not be ap-
plicable or suitable, and in these short-circuiting or exclusion may be
safer, although these may appear at first to be less satisfactory than
direct treatment of the fistula. The writer has found this method very
satisfactory when a fæcal fistula or artificial anus in the small intestine has
led to rapid wasting with excoriation of the skin. A wound at some
distance from the fistula is cleaner and fewer adhesions are to be met,

A.   B.   C.
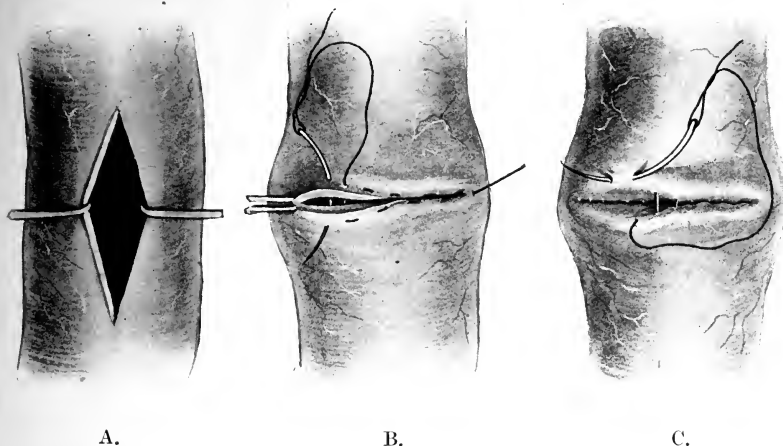
Fig. 194.   Intra-peritoneal closure of fæcal fistula.   A, The margin of the fistula
has been excised and the wound is made transverse by traction.   B, The opening
is closed by a Connell suture.   C, The Cushing or serous suture is shown.

so that the operation can be completed with greater speed and also with
more certainty of healing of the bowel and parietes, because the tissues
to be sewn are healthier.

The following is a good example of this.

A boy, aged 10, had acute intestinal obstruction following appendicitis, and
when seen in extremis all that could be done was to make an enterostomy in the
distended ileum above a mass of adhesions. The fistula would not heal, and some
three weeks later, when the boy was wasting away, the abdomen was re-opened
in the hope of removing the cause of obstruction. This hope proved vain, for the
lower two feet of ileum and cæcum were hopelessly adherent together and to the
pelvis. Therefore the ileum was divided just above the fistula and the obstruction,
a small piece of bowel including the fistula was excised, the cæcal end was tied
and inverted, and the proximal end was implanted in the upper part of the sigmoid
colon. The anastomosis and the stump were placed amongst neighbouring coils
of small intestine and the abdomen was closed. The boy did very well, except
that occasionally he had attacks of diarrhœa due to accumulation of scybala in
the cæcum. Large enemata and saline purgatives always gave prompt relief.
Five years afterwards the patient was seen quite well and strong, and free from all
abdominal symptoms.

[1] *St. Thomas's Hospital Reports*, vol. xiii, p. 181.

Tuberculous disease with fistulæ, especially common in the ileo-cæcal region, may be too extensive and adherent or the patient too feeble for resection to be contemplated. Unilateral or bilateral exclusion may then be resorted to and may give much relief if not a complete cure.[1]

A fistula in the lower part of the cæcum is best closed by excision of the greater part of the cæcum and suture without interfering with the ileo-cæcal valve. Duodenal fistula, occasionally following perforation of an ulcer, is best treated by gastro-jejunostomy with occlusion of the pylorus, although temporary jejunostomy is sometimes all that can be done in the marasmic subjects of this high fistula. Fistulæ between the small intestine and the vagina or bladder may be treated by detachment and plastic repair of the opening thus left; sometimes bilateral exclusion is safer, and the small segment of bowel atrophies and ceases to discharge. Fistulæ between the pelvic colon and the bladder, often associated with diverticulitis, are best treated in a similar way. Sometimes the affected part of the bowel is resected at the same time. Malignant fistulæ between the pelvic colon or rectum and the bladder are best treated by colostomy.

B. Closure of Artificial Anus. As long as there is a well-marked or complete spur there is no hope of spontaneous cure, and but little prospect of success from any plastic operation short of resection. When the artificial anus is low down and especially in the large intestine, some time can be devoted to the abolition of the spur. Sometimes the affected piece of bowel sinks in of its own accord, the spur recedes, and the opening closes. The pressure of a truss is very rarely successful and is usually painful. The spur may be destroyed by means of Paul's enterotome, which grips and exerts spring pressure upon the spur. The pressure can be increased at will by means of a screw, and the instrument bites through in three or four days. The Kentotribe of Von Mickulicz exerts more gradual elastic pressure and takes several days longer. A similar instrument may be used to make a window through the base of the spur when the two pieces of bowel are in contact for some distance from the aperture. This makes the subsequent operation for closing the fistula much easier and often makes a resection unnecessary. This is the usual method used so successfully by Mr. Paul after resection of growth of the large intestine. He always sews the two parallel tubes of bowel together at the time of the resection, so that the subsequent use of the enterotome is easy and unlikely to grip another piece of intestine. (Fig. 174, A and B, p. 306.)

The late Sir Mitchell Banks [2] used the following simple and ingenious method, and when the septum or spur is not well developed it may be expected to succeed. Into an artificial anus in the groin after a strangulated femoral hernia he introduced a thick piece of rubber tubing, pushing one end up and the other down the bowel. It was secured by a silk suture brought out of the fistula. The elastic pressure of the tubing pressed the spur back and allowed the fæces to turn the corner and enter the bowel below the fistula. At the end of seven weeks all the fæces passed by the rectum, and the sinus in the groin healed within three months. This is a tedious process but a safe one. It is most suitable when the artificial opening is low down, and the spur is incomplete. It is often valuable as a preparation for a radical operation, for it serves to

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[1] Mr. Roughton (*Lancet*, 1902, vol. ii, p. 1128) showed a man, before the Harveian Society, in whom he had anastomosed the ileum to the ascending colon for tuberculous fistula of the cæcum. No fæcal discharge came through the fistula, which remained open.

[2] Clin. Notes, p. 94.

prevent atrophy of the lower bowel and to give us information concerning the latter, especially when the artificial anus has been made to give rest for ulcerative colitis. If the fæces upon reaching the rested bowel again cause recurrence of symptoms it is clearly too soon to attempt to close the artificial anus. It is always a dangerous and troublesome business to close an artificial anus in these cases. One of the operations already described under fæcal fistula may be tried and may succeed if the spur has been abolished. Resection or short-circuiting has to be adopted if the spur cannot be removed either by preliminary treatment or at the operation. In the large intestine resection is not so necessary or safe as in the small, nor is it so safe as short-circuiting with or without suture of the artificial opening.

The following case is an example of short-circuiting for artificial anus.

The writer excised the lower two feet of the ileum for gangrene resulting from volvulus above a mass of adhesions following a bad attack of appendicitis treated conservatively. The pelvis was full of foul pus. When the cæcal end of the ileum had been invaginated the operation had to be abandoned as the patient seemed to be dying. A Paul's tube was hurriedly tied into the open end of the ileum. After repeated infusions and constant attention by the clinical assistant, Dr. Darke, the patient rallied. Sixteen days later she was utterly miserable from the intolerable irritation of her abdomen by frequent discharges of the acrid contents of the small intestine. She was wasting rapidly. A rubber tube was passed into the fistula for several inches, the fistula and raw surface were covered, and an incision was made far above and to the left of the original wound. The part of the ileum containing the tube was immediately identified, tied, clamped, and cut across between the ligature and the clamp after packs had been placed. The ligatured terminal end was invaginated with two purse-string sutures and the proximal end was implanted into the first part of the transverse colon. The whole operation was completed within fifteen minutes because the patient was so very ill. She made a good recovery and two years later had another baby (the ninth) at the age of forty-six, although it had seemed that such extensive adhesions were likely to be present in the pelvis as to render the abdominal ostia impervious. Some time later the blinded test-tube-like piece of lower ileum turned inside out and prolapsed. This was excised.

ENTEROPLASTY

This term has been given to an operation for the relief (short of resection) of strictures of the intestine believed to be innocent. It is based upon a similar operation which used to be performed upon the constricted pylorus and the first part of the duodenum following upon simple ulceration (*see* Fig. 194, p. 365).

Innocent intestinal strictures are very rare, but they may arise from contraction of tuberculous ulcers of the small or large intestine, or they may follow dysenteric ulceration of the latter. Sargent [1] has related three cases of stricture of the small intestine following strangulated hernia. Mr. Sargent also presented a Table of eighteen collected cases, including his own. In six of these there were two strictures, and most of the single strictures were extensive and not annular. In six no operation was performed; in two enteroplasty was performed successfully, one by Mollard and Bernay and the other by Abbott.

Primary resection was successful in three cases, and secondary resection after a preliminary enterostomy succeeded in another case (Alexis Thomson). Enterostomy failed to save three late cases. Lateral anastomosis was successful in one case. One patient died of peritonitis, although the anastomosis did not leak.

[1] *Ann. of Surg.*, 1904, vol. xxxix, p. 733.

The late Mr. H. W. Allingham's two cases of enteroplasty were the first to be published.[1] One such stricture occurred in a woman, aged forty-eight, at the junction of the ileum and jejunum, the other in the sigmoid of a patient aged seventy-three.   It is simply stated that " the stricture was innocent," and " not malignant."   As the cases were published within two months of the operation, the nature of the stricture must remain very doubtful. The age of the last patient, the site of the stricture in the sigmoid, and the absence of any history of dysentery are very suspicious, although there are several specimens of innocent stricture of the colon in the Guy's Hospital museum, careful microscopical examination having failed to discover any sign of carcinoma.   Some of these are undoubtedly tuberculous.   In each case the stricture was divided in the following way : The bowel having been drawn out, shut off with sponges, and clamps applied above and below, the bowel and stricture were divided longitudinally for three inches on the side of the gut opposite to the mesenteric attachment.   Each lip of the longitudinal incision was seized at its centre, pulled apart so that at first it gave the appearance of a diamond-shaped opening, and then, by further pulling in the same direction, the original longitudinal incision was made into one transverse to the long axis of the bowel.   The opening was then closed, first with a continuous suture uniting the mucous membrane, and then by Lembert's interrupted sutures.   It is better to make the deep stitch pierce all the coats, and thus to secure a firmer hold, as well as avoid the risk of eversion of the mucous membrane.   In any case of stricture of the large intestine, unless there is some very strong evidence in favour of its innocency, it is safer to excise it, for the chances in favour of the presence of carcinoma are enormous.

In many cases of stricture of the small intestine, enteroplasty, however ideal it may seem, may not be suitable on account of the existence of multiple strictures, or extensive ones.   Moreover, active ulceration at the site of the stricture is very common, and this may persist and lead to re-formation of the stricture.   It should also be borne in mind that carcinoma does occasionally occur in the small intestine, and even in comparatively young people.   In other cases of acute following upon chronic obstruction, the bowel may be so damaged, that enteroplasty is out of the question, and resection or enterostomy has to be adopted.

Sargent draws attention to the risk of spur formation at the mesenteric attachment in performing enteroplasty.   In some cases lateral anastomosis undoubtedly offers a better prospect, although for a narrow healed annular stricture of the small intestine enteroplasty is the simplest and safest operation.

[1] *Lancet,* vol. i, 1894, p. 1550.

CHAPTER XXII

CHRONIC CONSTIPATION OR CHRONIC INTESTINAL STASIS

CHRONIC constipation has attracted more and more attention during the last few years ; and as the chief cause of " Alimentary Toxæmia " it was fully discussed before the Royal Society of Medicine in March 1913. This discussion should be read in full.[1]

Widely different views are held concerning the *causes*, *results*, and especially the *treatment* of constipation. Sir Arbuthnot Lane believes the chief cause to be the erect position with the consequent formation of suspensory ligaments and membranes, which later cause kinking of the intestine. He thinks the results disastrous to health, chiefly from the absorption of toxins, causing widespread degeneration and disease. He attributes such common diseases as appendicitis, gastric or duodenal ulceration, cholelithiasis, and many others to one common primary cause— chronic intestinal stasis. He considers the treatment of the severe forms to be chiefly surgical. Should his fascinating speculations prove correct, he will have made another great contribution to surgery even greater than his original and enduring work on the operative treatment of fractures, which, at its inception, was met with much opposition.

Personally I am unable to agree with his views concerning either the pathology or treatment of constipation, although I freely admit that many of his patients are miserable subjects of extreme constipation, and that many of them are much better after operation. In some the improvement is not maintained, and some suffer from serious complications afterwards. Still I maintain that the same improvement can be obtained by painstaking and rather tedious but safe medical treatment. When this has been very thoroughly tried in vain an exploration is advisable and will probably reveal a definite mechanical cause. It is particularly important in a book of this nature, chiefly intended for beginners, to remind the reader that operations which are not very risky in Lane's magic hands are none the less formidable and dangerous procedures when too lightly undertaken by his less expert disciples. It must be remembered always that constipation itself does not cause death but can be successfully treated or at least kept well under control by safe means, which do not call for expert operative skill but are available to all who are willing to take a little trouble.

Although Sir Arbuthnot Lane's views do not seem to be supported by adequate proofs, or to find much favour as yet in this country, they are certainly worthy of our serious consideration. Time will prove whether they are right or not. Therefore I think it best to give his

[1] *Proc. Roy. Soc. Med.*, 1913, vol. vi, Nos. 5 & 7, Supplement.

own words [1] and illustrations, which he has kindly allowed me to borrow.

"In civilisation the trunk is retained in a vertical position during the entire daytime, the reclining posture being only assumed at night. Even then the horizontal posture is modified in character from that normally assumed in savage life. The resting posture of the trunk is the prone position, which is that which is naturally assumed in sleep upon the ground. While in the erect position of the trunk all the viscera tend to displace downwards towards or into the true pelvis, in the prone position the tendency is for them to fall upwards and forwards out of or in a direction away from it. If these attitudes were assumed in a normal association the structures in the abdomen would retain their normal relationship to the abdominal wall and to one another. If, however, the attitude of activity is not compensated for sufficiently by the corresponding resting posture changes will certainly take place, varying in degree with the failure of compensation. It is now our business to study in detail the changes which arise in the several abdominal structures in consequence of this. The portion which is affected in the first instance is our drainage scheme, or, as it is commonly described, the gastro-intestinal tract.

"The large intestine forms the cesspool of this tract. As it retains its contents for a comparatively long time, and as most of these contents are of solid consistence, it is natural that by its weight and situation it should tend to become displaced earlier in the lifetime of the individual.

"In the erect posture the cæcum and ascending colon become filled with more or less fluid contents, and by exerting a hydraulic pressure on the cæcum tend to tire out its muscular wall and dilate its cavity. By the same means there is a tendency for the dilated cæcum to be displaced downwards into the true pelvis, where its presence is detrimental to the true comfort and functioning of the viscera, to which that space normally belongs.

"This tendency to displacement in the cæcum in a downward and inward direction may be regarded as acting along the resultant of a parallelogram of forces, and to oppose this tendency resistances develop which correspond in position and action to the sides of the parallelogram. These lines of resistance are crystallised first as bands, and later as distinct membranes, which, as the outer limbs of the parallelogram, connect the peritoneum lining the abdominal wall to the outer surface of the colon in its immediate vicinity. A larger area of abdominal peritoneum and of colon is gradually involved, and later still, as is the case in all resistances which are crystallised in peritoneum, the bands are replaced by a layer of peritoneum which clings and tends to support the colon from the outside. As these bands and membranes develop, blood-vessels form in them which later may become sufficiently large to require to be ligatured if divided. This particular resistance, when fully developed into a membrane, has recently been termed 'Jackson's membrane,' and the manner in which it should be dealt with has afforded surgeons an excuse for doing many operations whose object is not very apparent, and which suggest ignorance of the factors determining its development as well as of its function. These crystallised resistances of peritoneum are not limited to the cæcum, but may extend up along the outer aspect of the ascending colon, even to the hepatic flexure.

"At this flexure a number of new bands are formed overlying the normal

peritoneum and attaching the flexure. These bands as they develop drag the flexure upwards, and in some cases produce a distinct obstruction. As they are fixed in close relationship with the right kidney, they not infrequently produce symptoms which are regarded as being renal in origin. In consequence of this the right kidney has been frequently exposed in an ineffectual attempt to find a stone, and the surgeon has subsequently been agreeably surprised to find that his patient has been relieved of his pain merely by the exposure of the kidney. The relief, usually temporary, really results from division of many of these bands and the freeing of the obstruction at the hepatic flexure. The bands or membranes are liable to constrict the lumen of the ascending colon usually at the level of the crest of the ileum.

"The inner limb of the parallelogram of forces is represented at an early period by opaque streaks on the under surface of the mesentery, attaching the last few inches of the ileum, and commencing at its base at a point most distant from the bowel. The reason of this development is obvious. Besides retaining the end of the ileum in position, the mesentery assists through the medium of the termination of the small intestine in holding up the cæcum and in tending to oppose its downward displacement.

"The thickening in the under surface of the mesentery becomes more distinct, and later develops into a membrane which extends to, and secures, the under surface of the circumference of the ileum, and gradually creeps around it till it reaches that portion of the circumference immediately opposite to the attachment of the mesentery. As it extends around the ileum, it also contracts, with the result that it twists the ileum on itself along its longitudinal axis. In its earliest development, as is the case with most conditions which evolve during the lifetime of an individual, because of a variation from the normal in the relationship to his environment, the effect of this acquired ligament or mesentery is useful and physiological, but later, when it kinks and obstructs the lumen of the ileum, it exerts a progressively deleterious effect on the well-being of the individual. I have already called your attention to the harm done by structures which, when first evolved, perform a useful function, but later produce effects which are progressively deleterious. I have indicated the mechanics of these crystallised resistances in figures.

"Fig. 195 represents the distended loaded bowel dragging upon the resistances evolved to oppose its downward displacement into the true pelvis. The resistances external to the cæcum are indicated as arrows showing the general direction of the strain exerted by bands, adhesions, and omental structures. The lowest of these secures the appendix, which in these circumstances is kinked. The effect exerted upon the ileum at its point of fixation by the weight of the loaded cæcum on the one side of it, and by that of the obstructed loop of the ileum on its proximal aspect, is figured in the diagram.

"It is clear that in this condition the inner limb of the parallelogram of forces is represented by the portion of the ileum distal to the kink, by the contracting acquired membrane which creeps around the circumference of the bowel, and by the posterior layer of the mesentery to which the membrane is attached. The upper layer of the mesentery presents no change, as abnormal strain is not exerted along it but through the under layer only. In these circumstances the portion of ileum between the cæcum and the attachment of the acquired ligament is made to perform

the function of a ligament very much more than is the case in the normal arrangement.

"In Figs. 196 and 197 are excellent clinical illustrations of this condition. They are contained in a paper by Dr. Charles H. Mayo in 'Surgery, Gynæcology and Obstetrics,' entitled 'Intestinal Obstruction due to Kinks and Adhesions of the Terminal Ileum,'[1] in which that distinguished surgeon describes his views on the causation of the condition.

"You will note that in the case here illustrated the appendix is fixed by the bands forming part of the outer limb of the parallelogram of forces, and that it has no anatomical relation whatever with the acquired evolutionary band forming the ileal kink, nor can it by any possibility have had any share in its causation. This may seem an unnecessary observation, but it is called for, since certain surgeons labour under the delusion that the band is produced by an inflammation that started spontaneously in the appendix. Against the supposition that these acquired bands or mesenteries are inflammatory in origin is the fact that they commence at the reflection of the peritoneum at a point most distant from the intestine, and then gradually approach and secure the bowel (see Fig. 197). Also they only exist on the surface of peritoneum on which strain is exerted, and they correspond accurately to the lines of force. The gradual growth of these membranes can be studied in every degree of development in the mesentery of the iliac colon. A very little consideration shows that the inflammatory origin is absurd.
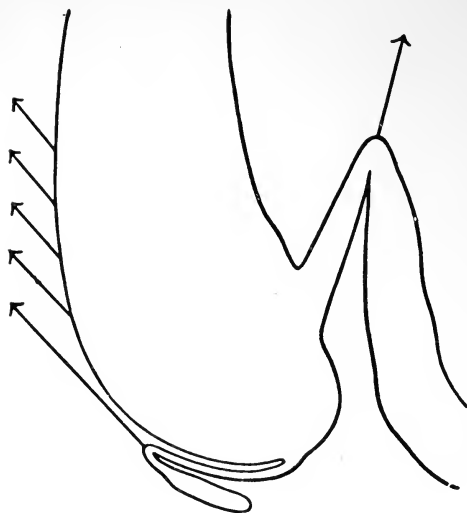
Fig. 195.

"I would also refer to excellent work on the same subject, as well as on stasis generally, by Dr. Franklin H. Martin[2] and by Dr. Coffey,[3] which has appeared in 'Surgery, Gynæcology and Obstetrics,' and with all of which you are doubtless quite familiar.

"From an examination of the several illustrations, it is apparent that any accumulation in the ileum proximal to the kink aggravates the obstruction more or less effectually, and that in the supine, and especially in the prone, posture the reduction of the strain exerted in the kinked bowel is probably sufficient in most cases to re-establish the effluent through it more or less satisfactorily. This is the explanation of the improvement which results in conditions presenting a marked ileal kink when the recumbent posture is assumed.

"A factor of more immediate urgency in the development of resistances to the descent of the cæcum is the share taken by the appendix. This structure being a firm one, and being securely fixed to the summit of the

[1] *Surg., Gyn. and Obstet.*, Chicago, 1911, vol. xii, p. 227.
[2] *Ibid.*, pp. 34-40.   [3] *Ibid.*, 1912, vol. xv, pp. 365-429.

cæcum, offers an irresistible attraction to the acquired or evolutionary bands. It may be gripped by one of them forming the outer limb of

FIG. 196. Shows the ileal kink with the band of peritoneum which produces it.
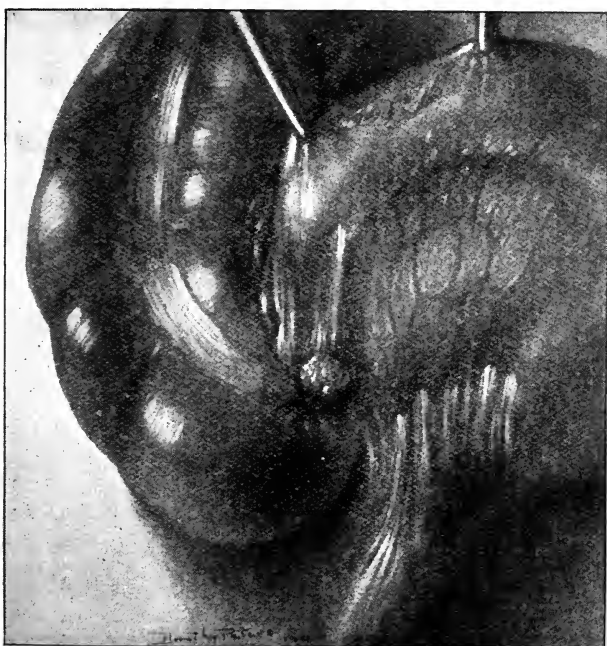
FIG. 197. Represents the condition after division of the controlling membrane.

the parallelogram as in Fig. 195, when the portion of its length, which intervenes between the point of attachment by the band and the cæcum, is made to perform the function of a ligament. Should the grip of the acquired band secure the appendix at a point in its length, it is liable to kink the appendix when the blind part distal to the secured

point readily becomes obstructed. The worst that such an appendix can do is to become inflamed, producing the condition called appendicitis. Should the appendix, on the other hand, form part of the inner limb of the parallelogram of forces, it is caught up at a point in its length, and is secured by an acquired band or ligament to the under surface of the mesentery. To reach this attachment it has to pass almost directly upwards behind the termination of the ileum. In these circumstances the inner limb of the parallelogram is formed by a portion of the proximal appendix stretched to its utmost and continued in the lower layer of the mesentery into a thick, dense, fibrous and peritoneal band, which has developed in order to secure it in this position. If the appendix is strong and the grip afforded by the acquired ligament or membrane in the under surface of the
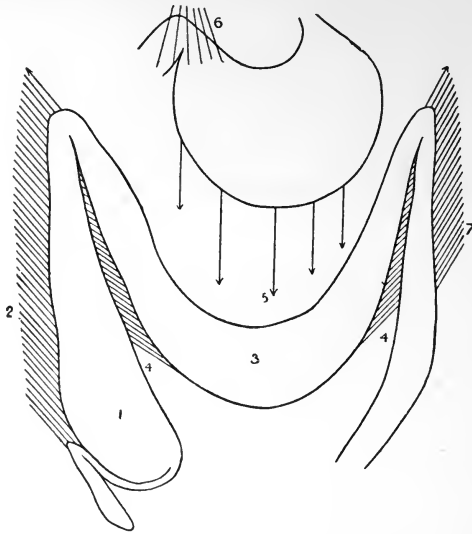
Fig. 198. 1 represents the prolapsed cæcum ; 2 and 7, the crystallised resistances which tend to oppose the downward displacement of the large bowel and sustain some of the weight of the transverse colon transmitted through the crystallised resistance 4 ; 3, the transverse colon ; 5, portion of the weight of the transverse colon transmitted through the great omentum to the convexity of the stomach ; and 6, the acquired ligament that secures the duodenum and pylorus to the under surface of the liver and gall bladder.

mesentery is secure and efficient, the acquired band which develops for the purpose of utilising the termination of the ileum does not form. If, on the other hand, the hold of the appendix in the mesentery is not effective in restraining the cæcum, in that proportion does an acquired mesentery and ileal kink result. When they co-exist the band fixing the appendix may become continuous with the band kinking the ileum. This has led those observers who consider that the fixation of the appendix is secondary to a primary inflammation of that organ to imagine that the membrane producing the ileal kink is also formed by an inflammation of the appendix. A careful examination of the condition at once disposes of such a supposition (see Fig. 198).

" The appendix, fixed to the mesentery, exerts a pressure upon the end of the ileum, when the cæcum falls into the pelvis and the ileum becomes dilated and distended behind the control, which is exerted by the unyielding and practically rigid band formed by the proximal portion of the

appendix and the ligament which secures it. As the appendix is usually gripped in such a manner that only a portion of its length is held by the acquired ligament, the portion distal to this, as already pointed out, is liable to become obstructed beyond its kink, and an inflammation of its distal extremity, or in other words an appendicitis, may arise. Therefore, such an appendix, by acting mechanically, may not only produce all the consequences associated with the damming back and fouling of the contents of the small intestine, but its end becoming inflamed, it adds to these mechanical symptoms those of appendicitis.

" It has been observed by certain operators that the removal of the appendix may occasionally bring about a cure of such conditions as duodenal ulcer, &c., and it has been suggested that duodenal ulcer and allied conditions are produced by an infection by organisms which grow in the appendix, or it is assumed that they may be produced by other infections, e.g. pyorrhœa alveolaris, &c.

" While the fact is correct that the removal of the appendix is occasionally followed by the cure of duodenal ulcer and allied conditions, the explanation of the phenomenon is incorrect. The ulcer and other allied conditions get well because the appendix, which was removed, had controlled the effluent in the ileum, and the freeing of this ileal effluent has of necessity relieved the results of its obstruction, of which the duodenal ulcer was one and only one (see Fig. 198).

" The problem of ileal obstruction, either by an ileal kink or by the pressure of an appendix secured to the back of the mesentery, or by both sharing in the production of obstruction of the ileal effluent, is one of the greatest importance and frequency." . . .

. . . " Returning to the large bowel, the transverse colon tends to drop. Part of its weight is transmitted to the convexity of the stomach through the great omentum and part through an acquired mesentery, which develops between the convexity and the ascending and descending colon. This acquired membrane is the crystallisation of resistances to downward displacement of the transverse colon, and is in the first instance useful since it serves to relieve the stomach of strain. Later, by its contraction it renders the hepatic and splenic flexures more acute and affects deleteriously the passage of fæces through them. As I pointed out, this is the usual sequence in the case of changes which evolve during the lifetime of an individual. Much of the weight of the transverse colon is transmitted through the posterior layer of the transverse mesocolon, which shows distinct acquired thickening and sometimes independent membranes along the lines of greatest strain. The splenic flexure is, normally, much higher than the hepatic, and in cases of stasis it is still further elevated by the formation of membranes or acquired resistances, which by their progressive contraction accentuate the angulation and disability of this flexure. It is at the three flexures and especially at the splenic flexure, that inflammatory and, later, cancerous changes are liable to develop in consequence of the constant irritation due to the increasing obstruction. The descending colon is fixed in a manner similar to the ascending colon by acquired crystallised resistances, which serve partly to secure the colon and partly to transmit to the abdominal wall the weight of the transverse colon.

" The adhesions are liable in time, by their contraction, to exert an excessive strain on some portion of the colon, and to produce a constriction in the lumen of the bowel with the consequences which follow upon

it. Such an obstruction exists occasionally in the large bowel on the right side at the level of the iliac crest, where the abrupt change from a firm, bony relationship to that of a flaccid muscular wall renders the production of a kink more easy.

"Owing to the possession of a mesentery of some considerable length, the sigmoid is at a much greater distance from the abdominal wall than the cæcum and ascending colon, which are immediately adjacent to it,
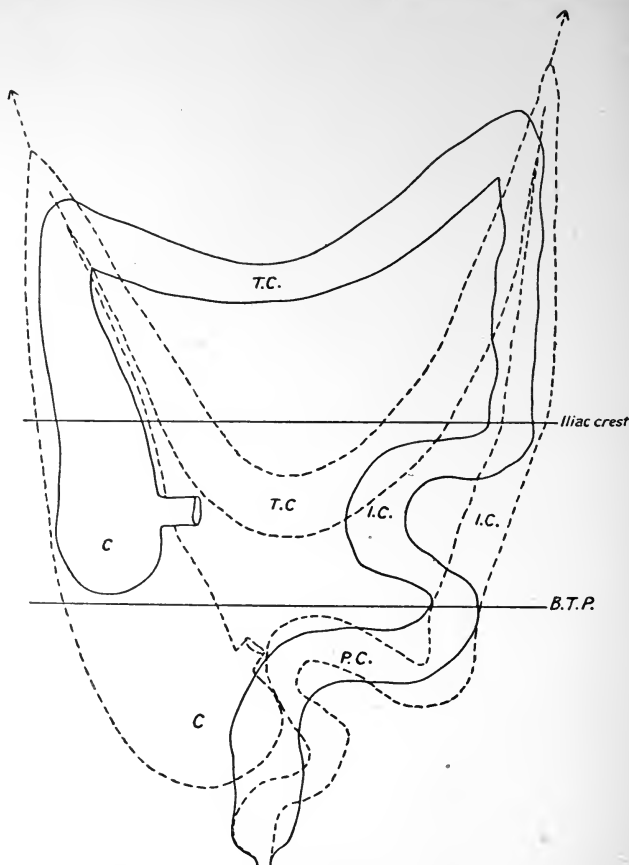
FIG. 199. Represents the several variations from the normal which the large bowel undergoes. The normal condition is shown as a firm outline, and the altered condition as a dotted outline. Note the prolapse of the cæcum and transverse colon, the telescoping of the iliac colon, and the elongation of the pelvic colon. B.T.P. indicates the brim of the true pelvis. The hepatic and splenic flexures are drawn up and kinked by the development of acquired resistances shown as arrows.

and the mode of fixation differs somewhat in detail from the last described. The outer surface of the mesentery is gradually brought down to its base by the formation of adhesions, till the wall of the iliac colon itself becomes secured to the floor of the fossa (Fig. 199).

"Associated with the progressive fixation of this loop there is a diminution of its lumen and of its length, so that the bowel, which normally forms a loop of considerable size, moving freely at the end of a long mesentery, finally becomes telescoped as a short, straight, constricted

tube, attached by a considerable area of its circumference to the abdominal wall quite devoid of any mesentery. In proportion as the bowel becomes fixed, its muscular coat wastes. The state of fixation and shortening of the sigmoid flexure, wasting of its muscular coats, and the general and occasionally also a very considerable local reduction of its lumen, and the obliteration of much of its peritoneal covering, are of great importance surgically, since they interfere very materially with the passage of material through the sigmoid and render any operation on this portion of the bowel abnormally difficult. In consequence of the irritation of the passage of firm fæcal contents through this fixed bowel, inflammation and later cancerous changes develop in it. The former condition—namely, the inflammatory one—has been dealt with in his usual masterly manner by Dr. W. J. Mayo in several papers under the title of ' diverticulitis.' The fixation of the sigmoid by the acquired adhesions may be of such a nature as to narrow its lumen in one or more places to such an extent that symptoms of obstruction may arise. This results from a failure of many of the bands of adhesion to secure a continuous grip upon the whole length of the mesentery of the loop. In consequence, the part, or parts, of the sigmoid which have become effectually anchored form kinks or obstructions, while the rest of the loop is distended. I have endeavoured to indicate this diagrammatically in Fig. 200. In this, the end of the descending colon, DC, is shown with the loop of the iliac colon and the upper part of the pelvic colon. The radiating lines represent the acquired adhesions which have secured the centre of the sigmoid loop, but have failed to grip the portions of the bowel above and below. Consequently the lumen of the intestine is reduced in two places, chiefly at the point where the centre of the loop is fixed, and to a lesser extent at the junction of the distal loop with the rectum.

Fig. 200.

" Owing to the bowel having escaped beyond the control of adhesions except at its commencement and termination, the sigmoid, instead of becoming shortened, atrophied, constricted, straightened, and fixed, may become very much more elongated, dilated, and mobile than normal, its muscular coat being correspondingly hypertrophied. At the same time the extremities of the loop held in the grip of adhesions are closely approximated, while the lumen of each is constricted, especially when the loop is distended with fæcal matter. This approximation of the extremities of the loop greatly facilitates its rotation.

" Fig. 201 is intended to represent the mode of production of a volvulus
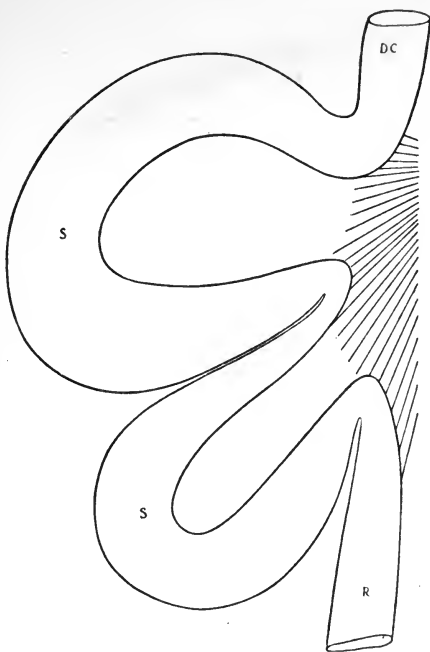
of the iliac colon (*see* Fig. 201). DC, S, and R indicate respectively the lower limit of the descending colon, the sigmoid loop, and the upper part of the rectum. The radiating lines show the acquired adhesions which have secured and approximated the extremities of the sigmoid, but have failed to obtain a uniform grip upon the mesosigmoid generally. The mode of obstruction to the passage of fæces from the sigmoid into the rectum is depicted. This obstruction may become more complete because of a rotation upon the loop upon the base formed by its approximated extremities or because of excessive sagging of the lower part of the loop exerting a drag on its lower limit sufficient to occlude its lumen. A certain amount of obstruction to the passage of fæces from the sigmoid into the rectum is always present. It is in these cases that complete intestinal obstruction may occur, owing to the twist or rotation of the overloaded and elongated loop becoming sufficient to prevent the passage of any material from the sigmoid loop into the bowel beyond. It will thus be seen that the so-called volvulus of the sigmoid (occurring spontaneously and not as an after-effect of an abdominal operation) is a phase of a condition of partial obstruction of long standing, the loop being habitually over-distended with intestinal contents, and the passage of fæces from it being chronically interfered with. I do not think that acute volvulus of a perfectly normal sigmoid
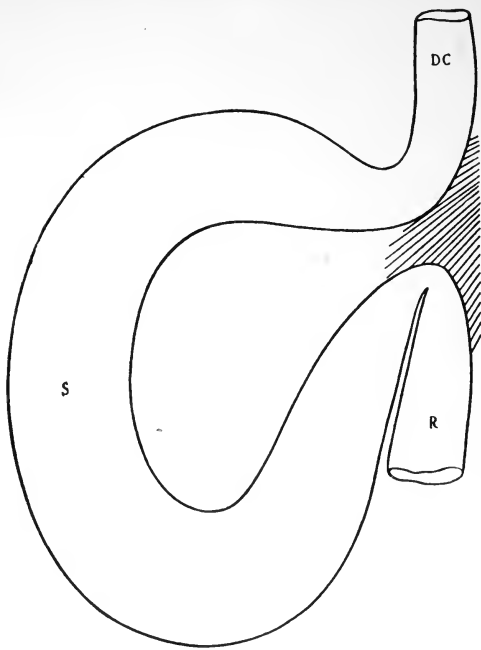
Fig. 201.

can occur spontaneously. The same remarks may apply equally to volvulus of the cæcum.

"I wish now to call attention particularly to the great importance of the last kink or obstruction which is developed in our drainage scheme and which affects the large bowel where it crosses the brim of the true pelvis on the left side. The fuller recognition of the function of this kink, the lowest in position, has helped me to understand the physiology of the large bowel both in the savage and civilised communities. It has also enabled me to deal surgically with the conditions of defective drainage of the intestine more effectually and at less risk to the life of the individual than I was previously able to do. This kink develops very early in life; indeed, I believe the bands which form on the outer surface of the mesentery of this portion of the large bowel, and which, like all other acquired mesenteries and adhesions, are the crystallisation of lines of resistance to downward displacement, are the earliest to form in the body. They appear before the erect posture is assumed. I have found them excellently developed in a child two years old, whom I short-circuited for

extensive tuberculous disease of the hip-joint. This band obviously
develops in order to resist the tendency to the downward displacement
of the large bowel into the true pelvis, where it would seriously incommode
the functioning of the several organs which already occupy it and is
continuous with those that secure the iliac colon.   As this new band or
mesentery contracts and becomes a definite ligament quite distinct from
the normal mesentery, on whose posterior aspect alone it exists, it fixes
the large bowel securely at this level, and performs a function of the
greatest importance.   It is so arranged as to oppose the backward passage
of fæces from the pelvic colon upwards into the large bowel, which is
likely to take place if this kink or obstruction is not efficiently developed.
It is often supposed that the fæcal matter moves continually onwards in
its progress through our intestines.   That this is not always so is shown
exceedingly well in those cases in which this particular kink or obstruction
is not developed.

"When I first performed ileo-colostomy for intestinal stasis, I divided
the ileum and put it into the iliac loop, as it was usually the portion
of the large bowel most readily and safely adapted for the performance of
this operation.   At the same time, great precautions were taken to free
the obstruction at the pelvic brim, to which I have just called your
attention, by dividing the new mesentery and suturing it over in such a
way as to try to obviate its re-formation.   This operation was frequently
followed by the passage of material back along the descending, transverse,
and ascending colon to the cæcum, often necessitating the removal of the
large bowel at a later date." . . .

"As a result, then, chiefly of habitual assumption of the erect posture,
certain mechanical or evolutionary changes take place in our drainage
scheme which result in a delay of the contents in part of the tract or
throughout its whole length.   I felt that the term 'chronic intestinal
stasis' describes most clearly the condition to which I wish to call atten-
tion.

"By chronic intestinal stasis I mean such an abnormal delay in the
passage of the intestinal contents through a portion or portions of the
gastro-intestinal tract as results in the absorption into the circulation of
a greater quantity of poisonous or toxic material than can be treated
effectually by the organs whose function it is to convert them into products
as innocuous as possible to the tissues of the body.   This condition can
be best studied in those whose habit it is to stand for long periods of
time." . . .

Symptoms.   "We will now consider the symptoms which result from
the delay in part or in the whole of the gastro-intestinal tract in conse-
quence of or in association with the conditions I have described.   I will
divide them into two groups—namely, those produced by obstruction and
those resulting from auto-intoxication.

"The symptoms produced by obstruction are those grouped roughly
under the head of indigestion, a term used to cover a great deal of ignor-
ance and much varied treatment.   They are chiefly pain, tenderness,
flatulence, eructation, &c.   These result from an inability to transmit
the intestinal contents at a normal rate and from the decomposition of the
material consequent on the delay in its transit.

"I do not propose to discuss the symptoms of the subsequent conse-
quences of this distension, such as inflammatory changes in the mucous
membrane or in the ducts and glands communicating with this tract, or

of the last stage in the sequence—viz. cancerous infection—since they must necessarily vary with the prominence of the particular end result. The amount and degree of pain depend upon the character and locality of the obstruction, as do also the degree and extent of the flatulence. While the mechanical results of obstruction to the effluent in the drainage scheme are very important, they are trivial as compared to those brought about by the absorption of an abnormal amount of toxins into the circulation.

" When these poisons or the products of the conversion exist in excess in the circulation they produce degenerative changes in every tissue and in every organ of the body. It is probable that the textures of those organs whose business it is to convert, carry, or eliminate them, suffer more than do the other tissues of the body which are merely permeated by them. In proportion as the stasis is prolonged so under the influence of a progressive strain greater than they are able to bear, these several organs undergo a degeneration which proceeds with increasing rapidity as the condition advances. What the organs are which convert and excrete these poisons, what share each takes in the process, and how any organ is affected in its physiology, are very difficult to define accurately, especially as far as the ductless glands are concerned. We believe that the liver is the most important converter of these poisons, and that the kidneys and skin are the chief excretors of the products of conversion." . . .

. . . " I will now consider the effect on the several organs and tissues of the body of an excess of toxins or poisonous products in the circulation. Perhaps the most conspicuous result is the removal of fat. This brings about not only an appearance of premature senility, but also a series of changes of infinite importance to the individual, and especially to the female, in whom, for reasons I have already indicated, fat plays a far larger share in supporting important organs and structures than it does in the male. The changes in the position of the several organs which follow on the loss of fat serve to exaggerate the existing stasis in the gastro-intestinal tract and to produce a vicious circle. The removal of the pelvic fat results usually in a backward displacement of the fundus of the uterus, which rests upon the concavity of the rectum. When the woman strains to evacuate the contents of the rectum she drives the large gorged fundus vertically downwards and the rectal lumen is compressed between it and the sacrum, or the uterus may be bent forwards, partly on account of the loss of fat and to a large extent because of the degeneration of its muscular wall which exists generally throughout the body. Consequent on the engorgement and the displacement or kinking of the uterus, a number of changes take place in that organ which call for the attention of the gynæcologist. As we shall see, auto-intoxication plays so large a part in the development of disease of the female genito-urinary apparatus that the gynæcologist may also be regarded as a product of intestinal stasis. If women were not imperfectly drained the gynæcologist would not have been evolved. The removal of fat from the true pelvis permits of the greater descent of the cæcum and small intestines into that cavity and exaggerates the obstruction of the ileal effluent correspondingly. The kidneys move freely in the space behind the peritoneum in which they were originally supported by a cushion of fat and changes ensue in these organs should the escape of blood or urine from them be controlled by their altered relationship to adjacent structures.

" As regards the attractiveness of the woman, a matter of vital

importance to her happiness, the loss of fat is a most serious factor. The formation of wrinkles, the prominence of bones, &c., are all most distressing and conspicuous features. The buttocks also become flat and flaccid, instead of firm and round, partly because of the disappearance of fat which enters so largely into their formation and partly because of the associated degeneration of the large gluteal muscles. The breasts also waste and flop downwards, and the whole form and contour of the woman alters conspicuously in the most objectionable manner. The skin undergoes remarkable changes. It becomes thin, inelastic, sticky and pigmented, especially where it is exposed to any pressure or friction. This pigmentation is observed first in the eyelids, whence it spreads gradually over the face. The neck becomes brown and later almost chocolate-coloured. The skin of the axillæ, abdomen, adjacent aspects of the thighs, and that covering the spinous processes of the vertebræ, becomes progressively darker and darker, and defined areas of even darker pigmentation may develop on these stained surfaces. The secretion from the flexures also becomes abundant and offensive. In some of the cases I have operated on this symptom has been such a marked feature as to render the patient very objectionable to others." . . .

Treatment. " From the surgeon's point of view, the treatment of chronic intestinal stasis consists in facilitating the passage of material through the several portions of the gastro-intestinal tract, and so obviating the mechanical and chemical results of any fault or faults which may develop along its length consequent on the peculiar mechanical relationship of the individual to surroundings as involved in the complex conditions of the civilisation of the present day. In the vast majority of cases the use of a lubricating material such as pure paraffin, which precedes the passage of food, application of some spring support to the lower abdomen which tends to keep the viscera up, and to control the delay of material in the small intestines and cæcum, and the avoidance of the use of such proteid foods as poison the tissues if retained for an abnormally long time in the intestine, are sufficient for the purpose. When these methods fail, resort must be had to operative interference. The object of such operative treatment is usually to facilitate the effluent from the ileum, and so to remove at once from the area of the drainage scheme, from which toxins are chiefly absorbed, the filth which supplied them.

" As I have pointed out, the measures to be undertaken to bring this about depend entirely on the nature of the mechanical conditions which produce the stasis, and also on the state of the patient at the time. For instance, where the ileal effluent is controlled by an appendix which is hitched up behind the termination of the small bowel, the removal of the constricting band frees the lumen of the small intestine and restores it to its normal function more or less completely. At the same time, if in consequence of the stasis there are present marked rheumatoidal changes or tubercular infection, the emptying of the contents of the altered and dilated small intestine into the cæcum may not result in such an effectual clearing of the small intestine as will afford the sufferer sufficient spare energy to destroy the disease. In these circumstances, the only effectual way of bringing this about is by dividing the small bowel and introducing its extremity into the pelvic colon.

" The same applies with much greater force to the control of the ileal effluent by the acquired membrane which produces the ileal kink. This condition of obstruction is much more serious than that which is

brought about by the appendix, since it is very liable to recur whatever means are adopted to obviate its recurrence. Obviously, such a recurrence cannot arise in the case of the appendix. Also, for some reason or other, the free division of these bands and membranes occasionally results in the production of a peritonitis which may cause serious anxiety. Consequently, when the ileal kink is produced by any extensive arrangement of acquired bands, especially in the female subject, I prefer to short-circuit rather than merely divide the constricting bands. I believe that in many cases the risks of short-circuiting are less than those of division while the possibility of recurrence by the re-formation of these bands, is permanently removed. The necessity of following the same occupation which determined the obstruction originally in the case of the man makes such a procedure all the more advisable. The convalescence after the short-circuit is also much more satisfactory than that which follows the division of bands.

"If tubercle, rheumatoid arthritis, or any advanced condition of auto-intoxication be present, there is, to my mind, no doubt whatever as to the value of short-circuiting the patient. The more I see of these cases and of the excellent and far-reaching results that follow on this procedure, the more inclined I am to adopt it, rather than to effect what is frequently an unsatisfactory and temporary compromise. I believe that the operation that I call short-circuiting, which consists in the introduction of the ileum directly into the upper part of the pelvic colon, has not succeeded so generally as one would wish because the details of the operation have been imperfectly carried out. I have known many complaints of pain and diarrhœa after such an operation. This unfavourable result is frequently due to the fact that the surgeon has been satisfied with establishing the anastomosis alone, and has not closed in the interval between the mesentery of the ileum and that of the pelvic colon. The intestines have fallen down behind the junction till the termination of the ileum has done so also. This has resulted in a permanent or recurring torsion of the end of the ileum on its own axis, producing a varying degree of obstruction of its lumen and consequent pain and diarrhœa, these being due to incontinence caused by over-distension of the bowel behind the obstruction. The chief disadvantage of short-circuiting is the occasional tendency which exists for the material which passes from the ileum into the pelvic colon, if not evacuated very shortly, to ascend into the iliac colon. This can be met in the large majority of cases by the fixation of the colon to the posterior abdominal wall at the pelvic brim by exaggerating the last kink, should this kink be not already efficient. If this is done effectually the chances of material passing upwards into the large bowel are very much diminished. As I have already pointed out, one of the purposes of the formation of the last kink would appear to be to obviate the ascent of fæcal matter from the pelvic colon in normal conditions, should the contents not be evacuated at the proper time. The presence of a quantity of fæcal matter in the pelvic colon is inconvenient to the functioning of the other pelvic organs, so that if it is not expelled it is displaced upwards into a more commodious area for the time being. If the last kink be well developed this is obviated and the material continues to set up a reflex which leads to its being forcibly expelled. In a certain proportion of cases it is advisable to remove the large bowel also. This may be required by the ascent of fæcal matter after an ileo-colostomy, or it may be called for if the colon be much

dilated, and especially if its mucous membrane has been chronically inflamed. In such a condition as is called Hirschsprung's disease, the removal of the large bowel is generally required and the distension of this portion of the intestine facilitates its removal. It is not easy to draw a sharp line between the cases of stasis in which it is advisable to do a short-circuiting only and those in which the large bowel may be removed as well with advantage. If the patient is wasted and the abdominal wall is loose and flaccid, especially if tubercle or rheumatoid arthritis or other results of stasis are present, I much prefer to remove the large bowel at the same time as I short-circuit, but if I feel I can save the patient any risk whatever by doing the operation in two stages, I prefer to do so.

"The only risk of short-circuiting or removal of the large bowel which is associated with the operation itself is the formation of adhesions. Against this there are apparently no certain means of prevention. We have tried many things applied to the intestine and have fancied that we have obtained better results from the use of silk cloths soaked in paraffin than with any other application. We are still in great doubt as to whether paraffin is of any use, but feel pretty sure that the best way to prevent the formation of adhesions is to avoid any unnecessary exposure of or damage to the intestines in the performance of the requisite manipulations and to be most careful in one's aseptic precautions. To me, the formation of adhesions and their subsequent behaviour is somewhat of a mystery, except in so far as I believe that they are due to sepsis in one form or another. If one could prevent the formation of adhesions the removal of the large bowel would involve no risk whatever to life. In the old subject who has had auto-intoxication for many years and also is feeble and wasted, there is a freedom from the development of adhesions which would appear to be due to an acquired immunity of the peritoneum to the organisms which are probably responsible for their development. At one time we were much troubled by suppuration in the incision in the abdominal wall in advanced cases. . . . By the use of hot compresses frequently applied we have reduced the frequency of suppuration in the wound to a minimum."

The opinions of some of the other distinguished contributors to the discussion already mentioned may be given.

Professor Arthur Keith (*loc. cit.*) said :

"I want to place before you the anatomist's point of view—so far as it bears on the present discussion. During the last twenty years our teaching and our research have been greatly influenced by the various movements which have culminated in the present discussion. In reality this discussion centres round the nature and function of the great intestine. I will deal first with the formation of peritoneal adhesions—a matter which has and which is receiving a great deal of attention from anatomists. We are at once brought face to face with one of the most striking of all the developmental changes seen during the growth of the foetus. There can be no doubt that man comes of a stock in which the mesentery and bowel were originally arranged in a primitive and simple manner, for in the second month of development the human intestine and its mesentery have the lineal arrangement seen in the lowest mammals. Then, during the third, fourth and fifth months of foetal life a profuse adhesive process sets in—a regulated embryological peritonitis—which leads to the cohesion of mesenteries and viscera to the posterior wall of the abdomen— an adaptation as we suppose to the upright posture, for it is only in those

upright forms that we find these adhesive changes take place. After the fifth month the process of adhesion proceeds more slowly, and is completed about the time a child learns to walk. The extent of the process is extremely variable. How variable it is one can readily see by consulting recent papers by Dr. Douglas Reid, the monograph by Dr. Henry M. W. Gray and Dr. W. Anderson, or the fine treatise on the appendix by Kelly and Hurdon. In about one newly-born child out of every ten the process of adhesion will be found to have bound the mesentery of the lower part of the ileum to the pelvic fossa, giving the condition which is associated with ileal kinking. The extent to which adhesions are produced between the cæcum and ascending colon varies, but a condition which gives rise to a ' Jacksonian membrane ' is not rare ; wide adhesions at the region of the hepatic and splenic flexures are always present—all these adhesions are parts of a normal embryological and useful process. We recognise, however, that all peritoneal adhesions in the ileo-cæcal region are not embryological and normal ; one sees occasionally in adult bodies a degree of adhesion never seen in the child at birth, and anatomists recognise that some of the adhesions are the result of pathological processes. The majority of the adhesions, often regarded as pathological in nature, are in reality mere expressions of a normal and healthy fœtal process.

" The question of ptosis or dropping of the viscera is also one which has interested anatomists. We had recognised the frequency of this condition before we were aware that Glénard had scheduled visceroptosis as a distinct pathological entity, and long before we succeeded in convincing our colleagues the clinicians of the frequency and the importance of the condition. It was a fortunate circumstance that at that time the discovery of Röntgen placed a new means of inquiry in the hands of anatomists. A study of the living diaphragm convinced us that the essential feature of the abdominal viscera is not their fixity but their mobility ; they were so attached that they could move freely with the respiratory tide. It became apparent to all of us that mesenteries and visceral ligaments only come into action when the limits of normal movement are reached ; the musculature of the abdominal wall is the essential mechanism for supporting the viscera. The pathology of visceroptosis is therefore to be sought in a better understanding of the nerve relationships which exist between the viscera and their supporting walls. The researches of Sherrington, Hill, Mackenzie, Elliott and many others show us how closely the tone and contraction of the abdominal parietes are related to the posture of the body and to the condition of the viscera. We have not yet solved the problem of how the tone and contraction of the musculature of the body wall and of the alimentary canal are co-ordinated, but we have sufficient evidence to lead us to suspect they are regulated by a common nerve mechanism. It is probable that this mechanism may be acted on and deranged by pathological products generated in the intestine and that visceroptosis is one of the manifestations of alimentary toxæmia." . . .

. . . " I now come to the essential question round which the present discussion has revolved—what is the functional value of the human great intestine ? At the beginning of the present century a sharp divergence of opinion set in. In the years 1902 and 1903 three men—an anatomist, Barclay Smith, a bacteriologist, Metchnikoff, and a surgeon, Arbuthnot Lane—came independently and by a different train of reasoning to the same conclusion, viz. so far as man is concerned the great intestine is not

only a useless but a pernicious structure. That is a very significant fact ; in Paris, London and Berlin the condition of the great intestine was then forcing itself on the attention of thoughtful medical men. To anatomists who knew that the great intestine was an intrinsic part of every air-breathing vertebrate, that it reached a high degree of development and specialisation in every mammal that included a vegetable element in its diet, that in all the animals immediately allied to man—his contemporaries and his very ancient predecessors, the great intestine was shaped, arranged and developed as in him, the conclusion that the human great bowel was a useless structure seemed a flat contradiction of every law applicable to the animal body. It is hard to believe that a great structure which has served that long chain of ancestors, carrying man's lineage through the secondary and tertiary periods of the earth's formation and assisting man to become the dominant and universal species of the world, should suddenly fail him. We seem drawn to the conclusion that it is not the organisation of the great intestine that has failed, but that our modern dietary sets a task for which it is not adapted. In civilised modern communities the great bowel has to manipulate a dietary such as was never before prescribed to it at any stage of its long evolutionary history. If an engine runs unsatisfactorily it may not be from a fault in its mechanism, but from a defect in the fuel. Those who regard the great bowel as a useless structure blame the engine ; for my part I stand by those who blame the fuel.

"Let us look at the evidence on which the useless and pernicious nature of the great bowel is based. The great bowel can be excised and health maintained ; that proves it is not an essential structure. If diseased, excision may lead to improved health ; that proves no colon is better than a diseased one. What must be proved, however, before we regard the colon as a useless structure is that a man without a colon is in a better state than a man with a healthy colon. It will be time enough to relegate the great bowel to the list of useless structures when that much is proved.

"This problem of the great bowel is really a child of our ignorance ; we have only a vague knowledge of its rôle in the economy of the animal body. If we keep before us the history of progress in medicine it is not likely that any one will presume, because we do not know the use of the colon, that it has no function and is a useless structure. Every year sees some structural part formerly placed with the useless or vestigial structures removed from that list. Only a few years ago Pavlov and Starling introduced us to the elaborate mechanism which controls the exit of the contents from the stomach to the duodenum ; it was certainly their investigations which led me to look for a similar mechanism at the junction of the ileum and colon.

"Elliott demonstrated that such a mechanism existed at the time he was carrying out research on the movements of the great intestine. I feel certain that Dr. Hertz is right when he attributes the effects, which Sir Arbuthnot Lane ascribes as the result of a kinking at the terminal part of the ileum, to a derangement of the ileo-cæcal sphincteric mechanism. Every step forward in our knowledge cuts the ground from under those who take a purely mechanical view of the action of the great intestine. Evidence I have accumulated lately justifies me in supposing that the mechanism for regulating the passage of food from the ileum to the cæcum of man is more elaborate than we supposed. Besides the muscular

fibres which are situated directly at the ileo-cæcal orifice and which evidently are designed to secure that orifice against reflux from the cæcum there is also another for regulating, as Dr. Hertz suggests, the passage of the contents of the ileum to the cæcum. The musculature of the terminal part of the ileum for an extent of nearly 4 in. (roughly 10 c.m.) above the ileo-cæcal junction is endowed with a special tonic function; it serves as a sphincter for the terminal part of the ileum."

Some of the remarks of Dr. Hertz are quoted because of his well-known and illuminating studies of this difficult subject.

" Even the symptoms, which are by common consent regarded as characteristic of chronic intestinal stasis, are by no means pathognomonic. The worst case I have ever seen of intestinal toxæmia, in which the classical symptoms of extreme emaciation, extensive pigmentation, evil-smelling sweat, and cold extremities were present, was due not to chronic intestinal stasis, but to chronic diarrhœa, the result of some intestinal infection contracted by a lady whilst big-game hunting in West Africa.

" It is not at all uncommon to be told by a patient, who is in the habit of taking large quantities of aperients for constipation, that the lassitude, headache, and abdominal discomfort from which he suffers, are better if he forgets to take his aperient and his bowels are not opened. His symptoms appear to be due to the absorption of poisons from the abnormally fluid fæces in his colon, and are therefore a result of the diarrhœa produced by his aperient, and not a result of his constipation. It is important before examining such cases with the X-rays that the patient should not take any aperient for some days. When this has been done I have often been able to demonstrate the complete absence of intestinal stasis, although many of the patients were contemplating some operation for the relief of their supposed constipation. The bismuth reached the rectum in the normal time, but the patients had become so convinced that their bowels would not act without help that they made no attempt to open them, as they did not feel the violent desire which resulted from the use of their aperients. When it was explained to them what the X-rays had shown, and also that a finger inserted into the rectum proved that it was full of fæces only waiting to be expelled, they were persuaded to try to open their bowels and succeeded in doing so. A gentleman, aged 38, whom I saw in April 1910, was convinced in this way, and he has had his bowels opened regularly ever since without treatment of any sort, although up to that time he was taking an enormous quantity of aperients, and was sent to see me for an opinion as to whether the colectomy, which had been advised, ought to be performed.

" It is well known that the frequency of the stools gives no certain evidence as to the existence of intestinal stasis. Thus a condition analogous to retention of urine with overflow may occur in the bowel, the patient being exceedingly constipated, but passing numerous small stools every day. On the other hand, in the condition aptly described as ' greedy colon ' by Sir James Goodhart, the patient may only open his bowels once every three or four days and yet be perfectly healthy; in such cases I have found with the X-rays that the passage through the bowels is generally normal in rate, but the quantity of fæces formed is so small that several days may be required for sufficient to collect in the pelvic colon to give rise on entering the rectum to the call to defæcation. By giving some charcoal with breakfast one morning and watching for

its appearance in the stools, the total time taken in its passage through the alimentary canal can be ascertained ; but this method gives no indication as to the part of the bowel in which the stasis occurs.

" We are therefore driven to the conclusion that the only reliable means of determining whether a patient is suffering from chronic intestinal stasis, and of ascertaining exactly what parts of the alimentary canal are at fault, is a series of examinations with the X-rays. It is, however, first necessary to determine whether large doses of bismuth salts interfere with the normal activity of the bowel ; for it has rightly been pointed out that they are among the best drugs for combating certain forms of diarrhœa. In order to test this point, Mr. F. Cook and Mr. E. G. Schlesinger, at my suggestion, took charcoal on a number of occasions at different hours in the day, their bowels being regularly opened in the morning at about 9 A.M. By this means they found the shortest time required for the charcoal to appear in their fæces. On repeating their investigations with 2 oz. of bismuth oxychloride added to the charcoal they found that the time was unaltered. I have since been able to confirm these experiments in a number of constipated individuals." . . .

From his careful investigations with the X-rays Hertz concludes that :

" When precautions are taken to prevent errors in diagnosis it is found that intestinal stasis never leads to gastric stasis.

" Intestinal stasis does not lead to duodenal kinking, dilatation, or ulceration, and duodenal ulcers are associated with an unusually rapid passage of chyme out of the stomach and through the whole of the small intestine."

Iliac Kinks, Iliac Stasis, and the Ileo-cœcal Sphincter.   " In 1903 Keith demonstrated the existence of a strong ileo-cæcal sphincter in man. It was thought by many that its function was to prevent the regurgitation of fæces from the cæcum into the ileum when anti-peristaltic waves passed down the ascending colon. X-ray investigations have, however, shown that antiperistalsis does not occur in man under normal conditions ; moreover, the ileo-cæcal sphincter does not prevent regurgitation into the ileum, as, in common with other observers, I have seen a bismuth suspension pass into the ileum when run into the colon through the rectum at as low a pressure as 1 ft. of water. There can be no doubt that the function of the sphincter is, as Keith originally suggested, to prevent the contents of the ileum passing too rapidly into the cæcum. Some recent observations made with Mr. Alan Newton, of Melbourne, have confirmed and amplified my earlier investigations on this subject. We have found that the bismuth-containing chyme reaches the end of the ileum an hour or even longer before any appreciable quantity passes into the cæcum and that the ileum is often still full four, five, or even more hours after the last traces of bismuth have left the stomach. Consequently an accumulation of chyme occurs in the last few inches of the ileum, where it remains and undergoes digestion actually for a longer period than in the stomach. During the whole of this period active segmentation, but very little peristalsis, can be seen. It is clear, therefore, that the function of the ileo-cæcal sphincter is to prevent the passage of the contents of the ileum into the cæcum until sufficient time has elapsed for digestion and absorption of foodstuffs to be complete, as the chyme which reaches the cæcum contains only traces of nutrient material in solution. Iliac stasis is thus a normal physiological condition of the utmost importance for adequate digestion.

" The ileo-cæcal sphincter begins to relax at infrequent intervals some time after the arrival of chyme in the end of the ileum, but only when another meal is taken does peristalsis occur at all actively in the extreme end of the ileum in addition to segmentation ; the sphincter apparently relaxes as each peristaltic wave reaches it, a great part of the contents of the end of the ileum being rapidly squirted into the cæcum.   In spite of this, if ordinary meals are taken after a bismuth meal, so that some bismuth remains in the stomach (in the manner already described) until the evening, the shadow at the end of the ileum may be visible in normal individuals until late at night.

" The normal iliac stasis is increased in all conditions leading to spasm or to the inhibition of the normal relaxation of the ileo-cæcal sphincter.   In acute appendicitis, for example, the sounds which normally indicate the squirting of the contents of the ileum into the gas-containing cæcum cease completely, owing probably to spasm of the sphincter, which Elliott has shown occurs in animals when the splanchnic nerve is stimulated or the neighbouring peritoneum is irritated.   In chronic appendicitis similar but less marked delay often occurs.   One of the most striking cases of iliac stasis I have ever seen was in such a case.   Six hours after the bismuth meal the stomach was empty, but no bismuth was present in the cæcum, all of it having collected in the end of the ileum, though in the average normal individual the shadow by this time would have reached the hepatic flexure.   The last few inches of the ileum could be clearly defined, as they were distended with chyme.   Palpation under the screen showed that there were no adhesions, the whole of the ileum being freely movable.   Twenty-four hours later some bismuth was still present in the last inch and a half of the ileum and a little in the cæcum and ascending colon, all the rest having passed to the rectum, from which some bismuth-containing fæces had just been evacuated.   It was clear, therefore, that the only stasis in this patient's alimentary canal was in the end of the ileum.   Mr. Rowlands operated and removed a diseased, but not adherent, appendix distended with pus, but found that the ileum was perfectly normal and was free from adhesions.   The ileocæcal junction was not abnormally narrow, so that it was clear that the stasis could have been due to nothing else than inhibition of relaxation or spasm of the ileo-cæcal sphincter.

" The end of the ileum, as it rises from the pelvis to join the cæcum, bends in various directions ; as the shadow on the screen is in one plane only, it is natural that it often appears as if it formed one or more acute angles or kinks.   It is obvious, therefore, that no conclusion of any sort can be made from skiagrams alone as to the presence or absence of kinks. By palpating the abdomen during the examination it is easy to demonstrate that most of these ' kinks ' are only apparent.   Sometimes the ileum appears to be fixed where it crosses the pelvic brim, but by manipulation the whole loop can be raised out of the pelvis, and the apparent adhesions and kink disappear.   Recently I saw what appeared to be a typical iliac kink, the ileum being fixed when it passed over the brim of the pelvis ; no amount of manipulation had any effect upon it, but on inflating the bowel in carrying out Bastedo's test for appendicitis the distended pelvic colon lifted the last part of the ileum completely out of the pelvis, and palpation now showed that there were no adhesions and no kinks.   I suggest, therefore, that before a diagnosis of an iliac kink be made with the X-rays the colon should be inflated, if palpation has failed to separate the apparent adhesion.

" Although there can, of course, be no doubt that abnormal bands may occur in connection with the terminal portion of the ileum, I do not feel at all convinced that they are of any importance except in quite exceptional cases, in which clear evidence of antecedent attacks of appendicitis can almost invariably be obtained. The obstruction offered by a genuine iliac kink is hardly ever as great as that normally offered by the ileo-cæcal sphincter 3 in. further on. Thus in the skiagrams published to illustrate the iliac kink the lumen is not always even narrowed. When it is narrowed, there is nothing to show that the narrowing does not represent a division produced by the segmentation, which normally occurs with great activity in the end of the ileum. Nothing short of almost complete stenosis could lead to stasis of any importance, as the contents of the ileum are always so fluid that they can pass through a very narrow passage without difficulty. A true iliac kink, if it ever really leads to iliac stasis, probably does not do so directly, but indirectly by inhibiting the relaxation of the ileo-cæcal sphincter, just as gastric adhesions may upset the pyloric mechanism.

" Conclusion.—Iliac stasis is a normal phenomenon and results from the action of the ileo-cæcal sphincter. Iliac kinks are comparatively rare, and do not directly increase the normal iliac stasis. The normal iliac stasis may be increased by spasm or absence of relaxation of the ileo-cæcal sphincter as a result of disease in the neighbourhood of the cæcum, including perhaps iliac kinks."

From his numerous examinations of the large intestine (in health and disease), with the X-rays and other means, Hertz concludes that ptosis of the intestines does not lead to stasis except in rare instances at the splenic flexure, a pelvic cæcum and a pelvic transverse colon being compatible with perfect health and normal intestinal action. In most cases of constipation a single part of the bowel, such as the rectum, pelvic colon, ascending colon, or splenic flexure, is involved, and treatment should, therefore, be directed to the affected part only. In those cases in which the whole of the colon is involved medical treatment almost invariably succeeds, but when it does not, ileo-sigmoidostomy, with or without colectomy, is indicated.

The following remarks by one of the greatest of American surgeons, William J. Mayo,[1] are important :

" Bands of adhesions are often developed during adult life. At the time of birth the cavity of the omentum is obliterated as high as the transverse colon. The process continues until in adult life points of adhesion are found as high as the pyloric end of the stomach, which obliterate the lesser cavity of the peritoneum to a greater or less degree. Similar conditions may exist between the omenta and the gall-bladder, and may be taken as evidence of infection. Various observers have asserted that the adhesions which sometimes exist between the epiploic tags of the sigmoid and the abdominal wall, &c., are of great importance, and always the result of pathologic conditions, yet such adhesions will be found in a certain percentage of necropsies on subjects over forty years of age, who during life showed no symptoms ascribable thereto.

" Jackson [2] has called attention to the veil of adhesions so often present between the ascending colon and the abdominal wall as a cause of pathologic symptoms. We can, at least, say safely that this condition, like the

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[1] *Amer. Jour. Med. Sci.*, February 1913, pp. 157–161.
[2] [*Surg., Gyn. and Obst.*, 1909, vol. ix, pp. 278–287.

others mentioned, is developmental in origin. The cæcum does not reach its normal situation until about the time of birth, therefore the attachment between this late arrival and its fixed place of abode is recent, and resembles adhesions of a peculiar pannus type. The weakness of this attachment on the right side is partially instrumental in permitting the prolapse of the cæcum into the pelvis. Wilms [1] believes this prolapse to be of great pathologic significance in producing cæcal stasis. 'Lane's kink' is undoubtedly also of developmental origin, and due to a fixation by bands of the terminal 3 in. of the ileum. The important question is, Do these conditions produce symptoms, or are they merely anatomic deviations without pathologic meaning?

"The transverse colon averages in length from 20 to 22 in., and has 10 or 11 in. distance to travel from the hepatic to the splenic flexures. Its supporting attachments in the centre are to the movable stomach, therefore prolapse of the transverse colon is common. There is little else it can do. The length of the transverse colon serves a physiologic purpose in picking up the final remnants of nutritive material. The X-ray photograph, taken with the patient in the standing position, with the weight of the bismuth in the stomach or in the transverse colon, or both, produces an exaggeration of this normal condition. How often can we say that it is truly pathologic?

"If the small bands of adhesions which are found in one case, such as a sigmoid epiploic tag attachment to the abdominal wall, be productive of so much harm in one patient, how can we expect that another patient with similar symptoms will be benefited by the bands of adhesions which the surgeon purposely forms to hold up a prolapsed organ like the cæcum? How much of truth and how much of fancy are embodied in the elucidation of this subject no one can say. That it is most obscure we all agree. One group of observers is convinced that the whole thing is mechanic, and the result of some type of infection rather than an error of development. Another group contents itself with the belief that these patients are all neurasthenics, although they are less ready to give an opinion as to the cause or nature of the condition. That many of the patients operated on have been greatly benefited cannot be denied, yet if one were to take the case histories and reports of successful treatment by means of such mechanic therapy, and put them all in a hat to be picked out at random, one could not determine from the histories of the patients those who had been relieved of symptoms by operating for a mobile cæcum, for relief of the adhesions, for mobility of the sigmoid, for fixation of the sigmoid, for prolapse of the stomach, and, for that matter, for movable kidney. The histories read alike, but the operations seem to vary with the bias of the operator. Are all these deductions wrong? Has the profession in regular medicine, with its accurate observations, no conclusions which depend upon more authentic data? To say that relief of symptoms demonstrates the truth of the opinion is not sufficient unless we grant the same privilege to the mental healers.

"I think we can agree with Arbuthnot Lane that metabolic changes may take place in the large intestine, which in some cases produce symptoms of disease, and that absorbable toxic products are responsible for many of the symptoms which are spoken of in a general way as gastro-intestinal neurosis, intestinal toxæmia, intestinal stasis, putrefactive intoxication, &c.

"It is probable that the first part of the colon, and especially the cæcum

[1] *Arch. d. klin. Chir.*, 1903, vol. lxix, pp. 795–842.

and ascending colon, will be found at fault. To it is delegated the difficult function of culling out the last nutritive remnants from the now infected mass of food.

"It is possible that all these mechanic conditions have some effect in detaining the infected remnants of food too long in the absorbing half of the colon, the symptoms being due to the effect of the toxic products absorbed on the controlling sympathetic ganglia. That the theory of mechanic causation alone is insufficient explanation is established by the fact that, as a rule, none of the ordinary results of mechanic obstruction exist, such as muscular hypertrophy of the wall of the bowel, &c. Quite the opposite condition exists—the bowel is thin walled and ballooned, the patients showing marked evidence of loss of sympathetic balance of the neurasthenic type, resembling in some respects a mild Graves' disease from hyperthyroidism.

"The views of Arbuthnot Lane,[1] Rovsing,[2] Coffey,[3] Jackson, and others should receive careful consideration. Whether or not the particular operations advocated by these surgeons are ultimately found to be correct, at least their work has called the attention of the profession to an important and heretofore neglected field, and offers a possible explanation of the cause of the protean symptoms in a large group of patients who have received much treatment and little benefit from the medical profession, and who have been exploited by the dietetic faddist and the charlatan."

The following remarks made by Sir Berkeley Moynihan before the British Medical Association at Brighton[4] are especially interesting :

"**The Source of Infection in the Abdomen.**—Among the most interesting and possibly one of the rich gifts of surgery to medicine is the hypothesis that intestinal stasis, with the associated condition of absorption of toxins, is responsible for many of the diseases which attack, not only the abdominal viscera, but even also parts remote therefrom. Perhaps no subject in medicine to-day has received more discussion, has been more bitterly assailed, more often attacked by derision rather than by argument, and more cheerfully supported than this. Its author, Arbuthnot Lane, is a man whose mind moves easily along new paths. Such a pioneer has often reached his destiny before other tardy travellers have set out upon the way. The pioneer in all branches of knowledge rarely himself reaches the truth, he is more apt to overreach, or to be content to guess the road that lies ahead without beating it down with his own foot tread. In contemporary surgical history many observers, as I have pointed out, have had their minds attracted to a firm belief in one thing—namely, that many of the diseases for which surgery is called upon to deal are not primary disorders, but are secondary ; that they depend for their existence and extended development upon some common cause ; and that this common excitant is an infection which expresses itself now in one way, now in another. The conditions I have already mentioned—ulcer of the stomach or duodenum, and cholelithiasis—are, in the belief of all of us who do much work for their relief, really dependent upon an infection. For my own part I look upon the appendix as the most potent and the most frequent cause of offence. Arbuthnot Lane takes a wider view. He believes that the intestine itself is the factory in which the poisons are

[1] *Surg., Gyn. and Obst.*, February 1908, p. 115.
[2] *Samml. klin. Vort.*, 1906, vol. xv, No. 431.
[3] *Ann. of Surg.*, January 1907, pp. 43–49.
[4] *Brit. Med. Journ.*, 1913, vol. ii, p. 174.

produced which cause, or make more easily possible, not only the various conditions I have named, but also such diverse and distant conditions as ' rheumatoid arthritis,' tuberculous diseases of bones and joints, diseases of the breast, cystic and malignant, of the thyroid gland, and many other conditions. At first it was supposed that the large intestine was the malefactor, and some slender support was possibly derived for the hypothesis from the work of Metchnikoff and others. More recently the delayed drainage of the small intestine has been held more blameworthy. Various bands and kinks have been described in different parts of the alimentary canal, and these have been held responsible for the obstruction, behind which dilatation and stagnation occur. Controversy has raged round the question as to whether these veils and kinks were developmental in origin, inflammatory, or evolutionary ; and very often the opinions of a writer are formed exclusively upon, or prejudiced by, the one out of many possible methods of examination to which he has devoted exclusive attention. The terminal ileal adhesion, for example, which is held by many to be the most powerful of all for evil, clearly owns at least two entirely different origins. The most common form of it, in my view, is that which depends upon inflammation of the appendix. But it is interesting to recall that in my book on ' Retroperitoneal Hernia,' published fourteen years ago, I point out that the ' physiological fusion ' of Toldt occurs to excess in two parts of the small intestine, with the result that there occurs ' an adhesion of the upper few inches of the jejunum, or the lower few inches of the ileum to the posterior abdominal wall.' I point out there, moreover, a possibility which is constantly overlooked, that this physiological agglutination is not a process which ends abruptly at birth, but that it continues afterwards ; it is possible, indeed probable, that it gradually advances during adult life. So far as the large intestine is concerned, my own experience points to the splenic flexure as the part where an arrest in the flow of contents is most prone to occur. Whether this is due to an exaggeration of the normal ligamentous attachments of the flexure, to its extreme fixity, or to the dragging effects of an overweighted and powerless transverse colon, I cannot say. But there can be no doubt that obstruction of the most acute, as of the most chronic, kind may be solely dependent upon ' kinking ' of the large bowel at its splenic flexure, surrounded and held firm by membranous adhesions.

"But these points, after all, are only incidental. The main question is concerned, not with the exact means by which effects are produced, but rather with the existence of the alleged effects. The fervid apostles of the new creed are a little prone to bewilder us with reasons for their immature observations. This is only to darken knowledge, and to encumber their religion with dogma. We need not yet be greatly exercised over the terms of an explanation of how these effects come about, for in medicine explanation often lags far behind experience. The most exemplary instance of the effects of alimentary toxaemia occurs, perhaps, in the condition which may best be described as Lane's disease. The miserable chronic dyspeptic with sallow skin, dirty tongue, flaccid belly, offensive breath, dusky lips and nails, cold extremities, and constipation that is with some difficulty overcome, is restored to health with incredible rapidity when a short circuit is made between the ileum and the pelvic colon. The claims that Lane makes in respect of such patients must indubitably be admitted. I have never in these cases, nor, indeed, in any

of ' alimentary toxæmia,' found it necessary to consider the question of a removal of the entire colon. As to the further claims which are made, I have not yet arrived at the point where I can admit them, but the hypothesis charms by its simplicity, and attracts by its magnitude, and I am travelling hopefully."

The following remarks were made by Dr. Hale White in concluding the discussion already mentioned :

" As the subject of this debate has been alimentary toxæmia it was to be hoped that from it we should learn something definite as to the toxins concerned. Unfortunately we have not. It is well known that the view of the Metchnikoff school is that poisons are manufactured in the intestine, especially the large, by micro-organisms, and these poisons produce the symptoms commonly comprehended in the term alimentary toxæmia, and that indol is one of the most important of these poisons, but although that view has been upheld by some speakers it has been severely criticised. . . . If the debate has done no other good, it has helped to make widely known that much of the bacteriological and biochemical work which has been done upon the flora of the large intestine and the poisons found there does not satisfy the standards of scientific accuracy. But there is a general impression that the poisons of alimentary toxæmia may, in many instances, be comparatively simple chemical bodies derived from the proteins of the food.

" It has been urged by several speakers that in consequence of the erect posture of man the intestines tend to drop, that to overcome this peritoneal bands are evolved, that they produce kinks, that these lead to stagnation of the intestinal contents, this leads to increased putrefaction, this to the formation of poisons, and that these, passing into the general circulation, cause definite symptoms and predispose to many diseases. Observers are by no means agreed as to the frequency with which these bands are found, nor, it is said, are they evolved as a result of the erect posture of an individual, because they may be found in the human fœtus and are in reality mere expressions of a normal and healthy fœtal process. The question will, it seems to me, have to be solved by anatomists. Are these bands to be found in all animals in whom the body is usually vertical, e.g. apes, gibbons, and penguins ? Are there evidences of them in animals whose bodies approach the vertical, e.g. giraffes ? Are there what might be called the reverse bands in bats, that spend so much of their time head downwards ? Here I might anticipate and point out that if these bands are present in all animals that adopt the erect attitude it would be of great interest to know whether such animals have intestinal stasis.

" Those who believe that evolutionary peritoneal bands often lead to intestinal stasis because they produce kinks, especially a kink at the last part of the ileum, think that, as a further result, a kink forms at the end of the duodenum, this and the stomach dilate and either may become ulcerated. This debate has not provided any statistical evidence to show in what proportion of sufferers from duodenal or gastric ulcers such kinks are found, nor has any experimental evidence been brought forward to show that in animals such ulcers form as a result of an artificially induced ileal kink, and we have heard one speaker say that intestinal stasis never leads to gastric stasis, nor to duodenal kinking, dilatation or ulceration, and that duodenal ulcers are associated with an usually rapid passage of chyme out of the stomach and through the whole of the small

intestine. It seems that the onus of proving their contention lies with those who believe that the above-mentioned phenomena follow intestinal stasis.

"We have seen that the ways by which intestinal poisons may be formed are so various, and the faults of our mechanism which may allow them to get into our bodies are so numerous, that proper treatment is in our present ignorance often impossible ; indeed, almost our only treatment, surgical or medical, is the very primitive plan of keeping the bowels well cleared out. Sometimes, indeed, Nature does that for us, for, as has been pointed out, severe alimentary toxæmia may exist with a diarrhœa which keeps the intestines almost empty. On the other hand, many people whose bowels are rarely open have not alimentary toxæmia. It is agreed that in the vast majority of cases medical treatment suffices, and what has been said about treatment in this discussion has come chiefly from the surgeons. Removing the colon has been mentioned, but a surgeon of wide experience tells us he has never seen a case in which he considered it justifiable. Short-circuiting the ileum into the sigmoid, too, has been discussed. Some say it succeeds, but it is clear it often fails to cure, and some surgeons prefer the simpler operation of appendicostomy. But if the cases that now seem to some to justify surgical treatment had been treated in the first stages by proper medical means, surgical interference would not be necessary ; so that when this is widely appreciated, cases ought never to become so severe that surgical treatment is contemplated, and we may hope that one result of this discussion will be that we shall keep ' the drainage scheme ' of our patients in sufficiently good order as to render surgical interference unnecessary."

I cannot leave this subject without giving my personal views very briefly. I am familiar with all degrees of chronic intestinal obstruction due to pathological adhesions and contractions at different parts of the abdomen, especially those that follow severe attacks of appendicitis, cholecystitis, and other inflammatory affections, and I have frequently operated for these, whenever possible releasing the bowel at the obstruction, but at times short-circuiting. During the general explorations which I usually adopt during laparatomies, I have often seen the various bands which are now said to be the causes and results of chronic constipation. Indeed, so frequent are they that I do not regard them as pathological but developmental and evolutionary in origin. They exist in healthy individuals, and within the bounds of health, they vary considerably in character and extent. It is possible they occasionally do harm, but I do not believe they commonly cause constipation or demand any treatment.

The causes of constipation are numerous, but chronic inattention to the normal daily habit is the most important one. Neglect interferes with the normal reflex act of defæcation, and leads to absorption of fluid from the fæces, leaving them dry and difficult to expel. Many children become constipated in this way ; simply because they hate the trouble or interruption entailed by the act of defæcation, or because they are not made to try at the right time, while the contents of the rectum are soft. The pain entailed in expelling large hard scybala causes further fear and delay. On examining the rectum is found to be full, and local stimulation produces the desired effect without resort to drugs. A little perseverance establishes regular habits and prevents the development of life-long constipation with atony of the bowel.

Similarly, nervous, pre-occupied and overworked people are very apt to become constipated because they are too modest, lazy or careless to adopt regular habits. They often eat and drink too little and take little or no exercise. In time atony and dilatation of the colon results, sometimes with much elongation, kinking or even volvulus.

INDICATIONS FOR OPERATION

Every endeavour should be made to arrive at an accurate diagnosis of the cause and site of delay, and suitable medical treatment should be patiently tried. If this fails and the patient's health is deteriorating, the abdomen should be explored and, if a mechanical obstruction is discovered, this should be treated by a suitable operation. In many cases it is sufficient to divide adhesions, remove an adherent appendix, or gall-bladder. In some cases a short-circuit is necessary, especially a gastro-jejunostomy for pyloric or duodenal stenosis. When there is an irremovable obstruction anywhere the short-circuit should be as near as possible to the obstruction, provided that healthy parts can be joined without tension.

In some cases a volvulus causing incomplete obstruction can be un-coiled and secured against recurrence by suture, or a short-circuit at the base. I have not performed colectomy for constipation except in one extreme instance of enormous dilatation of the colon (Hirschsprung's Disease) and the patient died of acute dilatation of the stomach soon afterwards. When no mechanical obstruction can be discovered, either atony or imperfect innervation of the bowel or the purge habit is the most probable cause of the constipation, and the best and safest treatment for this is appendicostomy with flushing of the bowel. If this fails ileo-colostomy may be added. If this combination fails colectomy may be considered.

Dr. Hertz has kindly allowed me to use the following quotation from the forthcoming second edition of his excellent and well-known work on constipation :

" When constipation is the result of definite organic obstruction of the intestine, surgical treatment is clearly indicated. But various operations have been recommended in the last ten years for the relief of constipation in the absence of this clear indication, and consequently the results hitherto obtained have only been satisfactory in a comparatively small proportion of cases. Though I have sometimes seen extremely gratifying results follow the surgical treatment of constipation, it has to my knowledge been the direct cause of death in several cases, and I have been consulted by patients, whose condition afterwards was either no better or was actually worse. I am therefore convinced that surgical treatment should only be recommended for chronic constipation if all of the following conditions are fulfilled.

" (1) Prolonged medical treatment, which includes much more than the mere use of aperients, has failed to give relief. By relief I do not mean cure, as many patients continue to be completely relieved of their constipation and the symptoms to which it has given rise so long as they continue medical treatment ; if, for example, a patient remains perfectly well, but has regularly to take certain drugs or requires an enema every morning, he should be content with this, rather than run the risk of the incomplete relief, the entire failure, or even the aggrava-

tion of symptoms or death, which may, however rarely, result from an operation.

" (2) An accurate diagnosis is essential. It is quite unjustifiable to perform any operation for the relief of constipation until all means have been taken to discover its exact cause. The part of the bowel in which stasis is present must be accurately determined as well as the presence or absence of dilatation, narrowing or adhesions ; in the case of the latter an attempt must be made to ascertain how far, if at all, they interfere with the normal intestinal functions. An X-ray examination of the stomach and intestines should therefore always be carried out, and the rectum and pelvic colon should be examined with the sigmoido-scope as well as with the finger. The stools should be inspected both whilst the patient is being treated and whilst the treatment is temporarily stopped, and in some cases they should be examined chemically and bacteriologically. Lastly, the history should be taken with great care and the patient's other organs thoroughly examined in order to determine whether the intestinal condition is primary and the cause of all the symptoms. I have seen two patients die as the direct result of the operative treatment of their constipation, which was really secondary to a gastric and duodenal ulcer respectively, and I know of cases in which the constipation and other symptoms were due to neurasthenia and in which an operation had the natural result of producing only a slight temporary improvement or no improvement at all.

" (3) The operation should be chosen to suit the particular condition found. It is clearly absurd to recommend appendicostomy, ileo-sigmoid-ostomy or colectomy as the routine treatment for a condition which has such a manifold pathology as constipation. In some of the rare cases in which surgery is required one or other of these operations may be indicated, but in others an operation devised to short-circuit or excise the affected part only and not the whole colon should be performed.

" (4) The dangers and possible unpleasant sequels of the operation should be weighed against the severity of the symptoms for which it is proposed to operate. I have on several occasions been appalled to hear from patients for what trivial symptoms they were contemplating a recourse to surgery. Appendicostomy is apparently quite free from danger to life, but in rare instances unpleasant local complications have occurred. All the other operations which have been recommended for constipation have a slight but definite danger. The mortality of simple short-circuiting operations is indeed very small, but it is greatly increased if adhesions are divided at the same time, and the mortality of partial and, to a still greater extent, that of complete colectomy is high, even in the most skilful and experienced hands. It is clear, therefore, that such operations should not be lightly recommended, and that they should only be performed for symptoms which are really severe enough to interfere considerably with the enjoyment of life or with the performance of the professional or other duties of the patient."

" (a) **Division of adhesions.** Believing peritoneal adhesions to be a frequent cause as well as a result of intestinal stasis, in his earliest cases Lane [1] attempted to relieve the latter by dividing the adhesions. The results obtained were, however, unsatisfactory, as it was very difficult to prevent the adhesions from forming again, even if all raw surfaces were

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[1] *Operative Treatment of Chronic Constipation*, London, 1904 ; *Brit. Med. Journ.*, 1908, vol. i, p. 126.

covered by peritoneum and complete hæmostosis was obtained before the abdomen was closed. Moreover, as I pointed out in an earlier chapter, it is probably quite exceptional for adhesions in connection with the colon to give rise to sufficient obstruction of its lumen to cause a degree of stasis which cannot be overcome without difficulty by medical means.

"More recently Lane has ascribed a very important rôle to the bands which form in connection with the end of the ileum. He believes that in some cases their division is all that is necessary to cure a case of intestinal stasis, although when they are very widespread, especially in females, he performs an ileo-sigmoidostomy instead of merely dividing the bands. I have, however, already explained how the importance of Lane's iliac kink has been exaggerated and shown that it is doubtful whether in the absence of appendicitis it even produces sufficient obstruction to cause stasis. Moreover Lane [1] has himself pointed out that the division of bands and membranes in such cases may lead to general peritonitis; I have myself performed the post-mortem on a patient with duodenal ulcer, in whom death had resulted from post-operative infection in the right iliac fossa after adhesions in the neighbourhood had been divided in addition to performing gastro-enterostomy, and Hughes,[2] having seen death from general peritonitis occur on at least two occasions from division of extreme iliac kinks, expresses his belief that it is incorrect treatment to divide the adhesions causing any but the slighter form of iliac kink, although these would appear to be the ones which least require dividing. Lastly, according to Fagge,[3] the operation often produces considerable disturbances owing to paralytic distension.

"It has already been mentioned that the form of dyschezia, in which there is difficulty in the passage of fæces from the pelvic colon into the rectum, is sometimes the result of chronic peritonitis, which has fixed the pelvic colon to the rectum or the pelvic floor. When enemata have failed to relieve such cases, Tuttle[4] recommends dividing the adhesions and, if necessary, fixing the pelvic colon to the abdominal wall, so as to prevent a recurrence of the condition. Up to 1903 he had performed the operation fifteen times with excellent results. More recently Lockhart Mummery [5] has published several similar cases, in some of which a short-circuiting operation was simultaneously performed.

"(b) **Short-circuiting operations.** The first short-circuiting operation for the relief of constipation was performed by Mansell Moullin [6] in 1900; he made a lateral anastomosis between the last part of the ileum and the pelvic colon without dividing the ileum. Shortly afterwards Lane, having found that simple division of adhesions did not give satisfactory results, began to treat cases of chronic intestinal stasis by division of the end of the ileum, which he implanted into the pelvic colon. In numerous papers Lane has described the results of his operation, which he has now performed on a very large number of patients suffering from the very varied conditions which he ascribes to chronic intestinal stasis. In many cases, some of which I have had the opportunity of seeing, the results have been very satisfactory; in others there has been little or no improvement, and in a small number of cases the operation has been fatal. In

[1] *Proc. Roy. Soc. Med.*, Supplement to vol. vi, p. 115, 1913.
[2] *Ibid.*, p. 231.   [3] *Ibid.*, p. 215.
[4] *Diseases of the Anus, Rectum and Pelvic Colon*, p. 554.   London, 1903.
[5] *Diseases of the Colon*, London, 1910; and *Proc. Roy. Soc. Med.*, Supplement to vol. vi, p. 181, 1913.
[6] *Trans. of the Med. Soc.*, vol. xxiv, p. 199, 1901, and *Lancet*, 1909, vol. i p. 156.

a number of instances fæcal material has collected in the blind end of the colon and given rise to unpleasant symptoms; this must have been due to the accumulation of the secretion of the large intestine, which normally forms a large proportion of the fæces, but is insufficient in bulk and in irritating constituents to stimulate the cæcum and colon to empty themselves without the aid of the contents of the ileum. It is probably also in part due to the overflow of fluid material arriving in the pelvic colon from the ileum, and Dr. Case has recently brought forward evidence which makes it probable that in some cases antiperistalsis carries the contents of the pelvic colon into the more proximal parts as the descending colon and sometimes the transverse colon may become visible after a bismuth meal. In these cases Lane excises the cæcum and ascending colon, and more recently the whole colon, as a secondary or, in some cases, as a primary operation. Perhaps this drawback could be more easily overcome by a simple ileo-sigmoidostomy without division of the ileum, as recommended by Mansell Moullin, although Lane believes that there is then a risk of the stoma closing, or by the simultaneous performance of an ileo-sigmoidostomy and an appendicostomy, which would make it possible to keep the proximal part of the colon empty by lavage through the appendix.

" The chief criticism of these operations as a routine method of treating intractable cases of chronic constipation is that in a large majority of instances only part of the colon is affected in constipation, as my investigations both with the X-rays and other means have proved. Thus in nearly half of the severe cases I have seen in consultation the rectum, or less commonly the pelvic colon, was affected alone; in none of these could an ileo-sigmoidostomy have been of the least use, as a normal colon would have been short-circuited and the abnormal pelvic colon and rectum left untreated. In cases of dyschezia due to obstruction at the pelvirectal flexure an anastomosis between the pelvic colon and the first part of the rectum has been established with success by Gant,[1] when medical treatment and division of adhesions with " sigmoidopexy " had failed to give relief. In other cases the cæcum and ascending colon are alone affected; as soon as the fæces get into the transverse colon their passage to the rectum is normal in rate. Such cases can generally be relieved by diet and drugs with the aid of massage applied regularly for a prolonged period to the affected part, and I have not myself seen a case in which I thought an operation was indicated. But if all medical treatment failed, an anastomosis between the ileum and the transverse colon, with or without the removal of the cæcum and ascending colon, as advised by Stierlin [2] and successfully performed by Wilms and de Quervain, seems a more rational and less dangerous treatment than ileo-sigmoidostomy, which may have to be followed by complete colectomy. In another group of cases the passage as far as the splenic flexure is normal in rate, but considerable difficulty is experienced in getting beyond this point. This is sometimes due, as I have already pointed out, to severe ptosis of the transverse colon, the splenic flexure remaining fixed, sometimes to unexplained muscular weakness of the distal part of the transverse colon, and sometimes to adhesions in the neighbourhood, as described by Payr. If such cases are examined by means of a barium enema it is generally found that the fluid run in from the rectum passes without difficulty into

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[1] *Constipation and Intestinal Obstruction*, Philadelphia, 1909.
[2] *Ergebnisse der innen Medzin*, vol. x, p. 385, 1913.

the transverse colon ; moderately large enemata without the aid of drugs or other treatment, with the exception of an abdominal support if ptosis is present, are then often successful. In two of my cases, however, all medical treatment failed to give relief, and Mr. F. J. Steward effected an anastomosis between the lowest part of the transverse colon and the pelvic colon in one instance, and between the limbs of the splenic flexure in the other, with satisfactory results.

"The comparatively rare cases in which the whole of the bowel is involved are generally amenable to treatment by diet, massage and drugs. I have, up to now, only seen a single case, out of the very large number I have examined with the X-rays, in which the whole of the colon was involved and in which, in spite of every form of medical treatment I could devise, the patient became steadily more and more poisoned and suffered from more and more pain. Sir Arbuthnot Lane operated on this case for me in December 1911, and the relief, which was almost instantaneous, has proved permanent and complete. I am therefore convinced that when the whole of the colon is involved, and when thorough and prolonged medical treatment has proved completely ineffective, an ileo-sigmoid-ostomy should be performed.

"(d) **Colectomy.** Colectomy, which Metchnikoff [1] believed would, above all things, help in the realisation of his dream of a " natural death " at the age of a hundred and forty, is the operation which Lane now performs at once for his severest cases of intestinal stasis and as a secondary operation in less severe cases, in which ileo-sigmoidostomy has not proved entirely successful. At first the cæcum and ascending colon were sometimes removed alone, but now a complete excision down to the pelvic colon is always performed. A series of thirty-nine cases of colectomy was published by Lane in 1908 ; of these a case of dysentery and one of ulcerative colitis must be excluded, and as some were described as cases of an " extreme condition of auto-intoxication " without details as to the symptoms pointing to their intestinal origin being given, it is not clear how many were really suffering from constipation. If the cases of dysentery and ulcerative colitis are excluded, there remain thirty-seven cases ; of these seven died as the immediate result of the operation, one died six months later from intestinal obstruction, and one a year later from exhaustion. The immediate mortality was therefore 19 per cent., and the total mortality 24 per cent. Out of sixteen patients who were alive a year or more after the operation ten were relieved to a greater or less extent, and in six the result was only moderately good. Eleven out of twelve operated on between a month and a year before the date of publication were much better, and in only one was a less satisfactory report received, but in these cases insufficient time had elapsed since the operation for a proper judgment of the results to be formed. Although a large number of other cases have been reported more recently, they have been selected ones ; in order that a more definite judgment can be formed on the operation it would be desirable to publish a complete series, including fatal and unsuccessful cases. Even if this were done, too short a period has still elapsed for a final judgment to be made. It is conceivable that an individual may be able to do without his colon for a time, but not for ever ; it is probable, for example, that a colectomised patient would suffer more seriously than a patient with a normal colon from certain forms of poisoning, such as lead-poisoning and uræmia, as the colon is the chief

[1] *The Nature of Man*, chapter iv. English Translation, London, 1903.

excretory organ for lead, for some of the poisons present in the blood in excess when the kidneys are diseased and for other poisons, which would be retained in the body if the colon had been excised. In this connection Moynihan's case of complete gastrectomy should be remembered. The patient remained perfect in health for some years, but finally died from gradually increasing malnutrition : at the autopsy no trace or recurrence was found and all the organs were healthy, indicating that a man may remain well for a time, but not indefinitely, without his stomach.

"The high mortality of the operation, even in the hands of a great abdominal surgeon, proves that it cannot be accurately described as an operation of only ' moderate severity.' The operation should only be contemplated under the conditions I described as making ileo-sigmoid-ostomy a justifiable operation. It is doubtful, however, whether it is ever wise to perform colectomy as the primary operation in such cases. When, however, an ileo-sigmoidostomy has been performed under the conditions described and has not proved successful, a colectomy may be indicated, but it is questionable whether the necessity could not be entirely overcome by performing an appendicostomy at the same time. Thus Mummery, who has recently recommended the latter combined operation, states that he has never seen a case in which he considered colectomy justifiable.

"The condition, for which colectomy is, in my opinion, most definitely indicated, is Hirschsprung's disease. As soon as medical treatment of this has been found to be ineffective, the case should be handed over to the surgeon ; the surgical treatment, which is discussed elsewhere, must generally end with a colectomy. The very rare cases in which an analogous condition of enormous dilatation of the colon is acquired in later life require similar treatment. I am convinced, too, that colectomy was the only treatment which offered any hope of success in Case 30 ; chronic constipation had led to the production of a volvulus of the pelvic colon and dilatation of the rest of the large intestine ; after the excision of the volvulus it was found quite impossible by medical means to restore the over-distended colon to anything like approaching a normal condition, so that its removal was the only course left open.

"(e) **Appendicostomy.** In 1905 Keetley [1] introduced the operation of appendicostomy as a method of treating chronic constipation, and more recently it has been strongly recommended by Lockhart Mummery. [2] After the operation the colon can be washed through the appendix with two or three pints of water or normal saline solution every morning : if the constipation is complicated by colitis an astringent can be added to the water, and in cases of infective origin antiseptic irrigations can also be used, but in muco-membranous colitis no astringent or antiseptic should be employed. Keetley recommends lavage with saline purgatives or cascara, but it is not obvious what advantage can be gained by giving them by the appendix instead of by the mouth, particularly in the case of the former, which, as we have shown, acts only after absorption into the blood. Appendicostomy has the great advantage over short-circuiting operations and colectomy in being comparatively easy and safe, as it does not appear ever to have been fatal. The opening into the appendix rarely causes any inconvenience, as it should merely form a small depression, from which no fæces, mucus or flatus escapes, and over which it is often

[1] *Brit. Med. Journ.*, 1905, vol. i, p. 1358, and *Proc. Roy. Soc. Med.*, November 1908.　　　　[2] *Loc. cit.*

unnecessary to wear any special covering. When considerable improvement has occurred the irrigations should be continued on alternate days only and subsequently twice and once a week for two or three months, after which the stoma is allowed to close spontaneously. In severe cases, however, the irrigations have to be continued indefinitely.

"Appendicostomy is specially indicated when the stasis is confined to the cæcum and ascending colon, as these parts can certainly be more effectively washed out from above by water introduced through the appendix than from below by water introduced by rectum. When the stasis is situated at or beyond the splenic flexure and especially in dyschezia, appendicostomy is less effective than enemata combined with other forms of medical treatment, even in the severe cases in which it proves necessary to continue the latter indefinitely. When there is any mechanical cause for the constipation and medical treatment has failed to give relief, an appendicostomy is less likely to be of permanent value than some short-circuiting operation, which attacks the cause itself. There is, however, no harm in trying the effect of an appendicostomy before the more radical operation, and it may even be desirable to do so in very emaciated, weak patients, so that an improvement in their general condition may occur before the severer operation is undertaken. Some surgeons wisely recommend that an appendicostomy should always be performed at the same time as short-circuiting operations, such as ileo-sigmoidostomy, in which the small intestine is completely divided, as by this means the accumulation of fæces in the proximal part of the colon, which has often made it necessary to perform colectomy at a later date, can be prevented."

Mr. Schlessinger, late house-surgeon to Sir Arbuthnot Lane, has kindly written the following excellent account of Lane's operations, and Sir Arbuthnot has kindly corrected and approved the descriptions. No complete account of the technique of these operations has appeared before.

ILEO-COLOSTOMY (short-circuiting)

"The preparation of the patient consists in thoroughly emptying the bowels by means of large doses of castor oil (℥ij or ℥iij) and enemata, and in limiting the diet of fluids for forty-eight hours before operation. Saline infusion into both axillæ is begun with the anæsthetic, and is continued throughout the operation, usually from four to six pints being administered. A vertical incision, from five to seven inches in length, is made, three quarters of an inch to the left of the midline, through the anterior layer of the rectus sheath. The rectus muscle is displaced outwards, and the posterior layer of the sheath is divided. The peritoneal cavity is now opened, and its contents thoroughly explored. Note is made especially of the presence or absence of Lane's kink, as to whether the ileal effluent is controlled by an appendix anchored to the mesentery, of the degree of duodenal and gastric obstruction and distension, and of the position and size of the band forming the 'last kink' (see Fig. 202).

"If ileo-colostomy is decided on, a mobile portion of the ileum, at a distance of about six to ten inches from its temination, is chosen, crushed by a pair of forceps applied at right angles to its long axis, and ligatured in the groove thus formed with stout linen thread. A pair of forceps is then placed on the ileum immediately proximal to the ligature, and somewhat
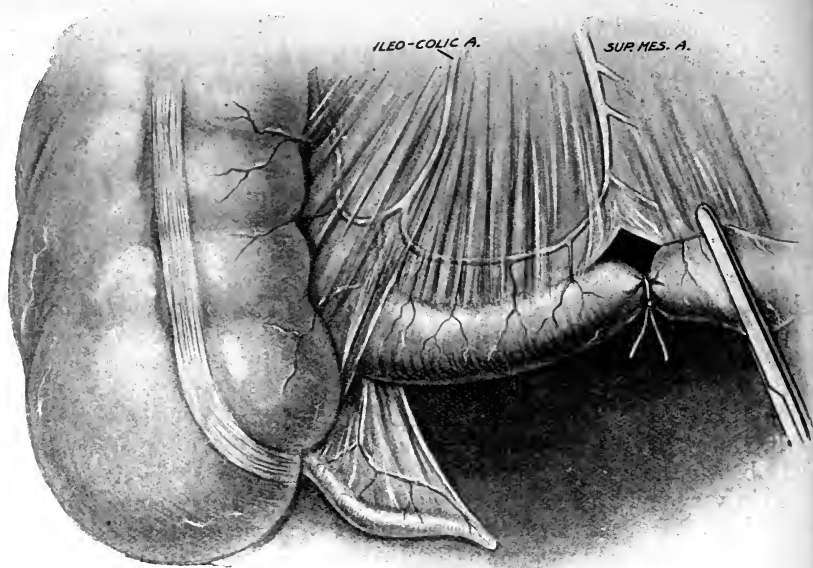
FIG. 202. Ileo-colostomy. The ileum, 6 to 10 inches away from the cæcum, opposite the bifurcation of the superior mesenteric artery, is crushed, tied, and clamped obliquely. The forceps are too far away from the ligature.
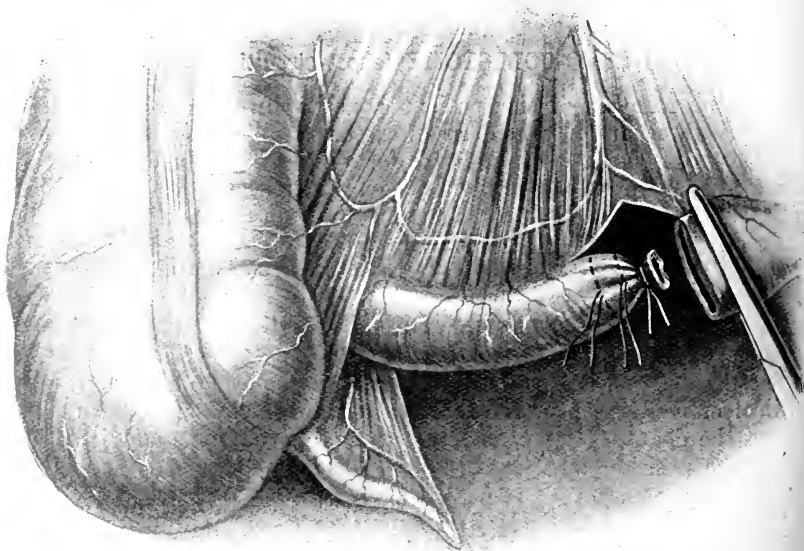
FIG. 203. Ileo-colostomy. The ileum has been divided with the cautery, and the terminal stump is ready for invagination by two purse-string sutures.

obliquely so that a larger lumen is obtained than by transverse section. The ileum between the ligature and the forceps is then divided with the cautery, its two ends are seared, and the ligatured distal stump is carefully invaginated and sewn over with fine silk (*see* Fig. 203).

"No mesenteric vessel of any size need be injured in this procedure, and the mesentery need only be divided for about an inch.

"A portion of the pelvic colon below the 'last kink' is selected, and one blade of a pair of curved stomach clamps is placed on it, parallel to its long axis, and free of its mesenteric border.

"The anatomy of the colon will be found to vary greatly in these
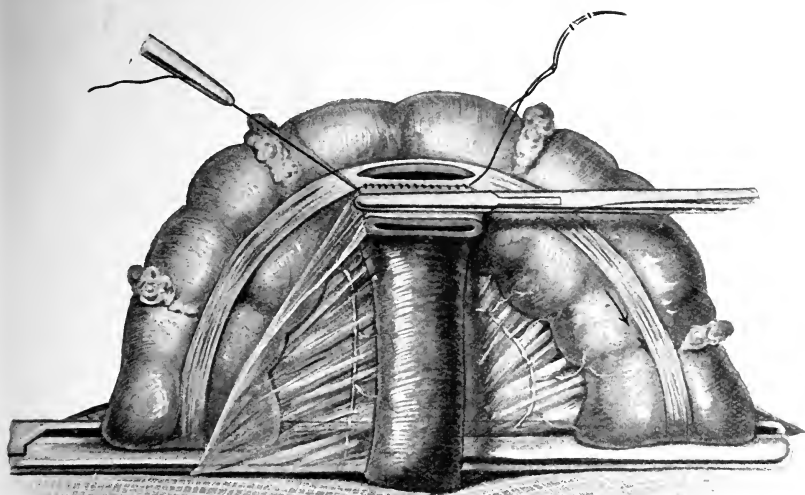
Fig. 204. Ileo-colostomy. The end of the ileum is secured to the pelvic colon by a sero-muscular suture near the attachment of the mesocolon and ¼ inch away from open end of the ileum.

patients, but the portion of colon to be chosen as the site of the anastomosis will usually correspond to the convexity of the loop of the pelvic colon should a loop be present. Otherwise, if the pelvic colon is very fixed, it should be clamped at any point accessible. In these circumstances, however, the operation may be one of very great difficulty.

"The ileum, its lumen having been controlled by a light-bladed forceps placed at some distance from its divided end, is now brought across, and arranged in a suitable position for an end-to-side anastomosis with the pelvic colon, the compression forceps which occlude its cut end lying beside the clamp on the colon, so that the mesenteric border of the ileum is directed upwards and its free border downwards.

"A suture of fine silk now unites the peritoneum of the two portions of gut, being inserted in the colon along the inner limits of bowel covered directly by peritoneum, and in the ileum about a quarter of an inch from the cut end. Its insertion in the ileum is facilitated by giving a half turn to the forceps holding the cut end of the gut, thus bringing its under-surface within easy reach (*see* Fig. 204).

"The colon is now opened by a longitudinal incision for a distance equal to the lumen of the section of the ileum. The forceps are removed from the end of the ileum, and the adjacent margins of the ileum and colon are united by a through-and-through buttonhole stitch. This form of stitch is employed in order to avoid any constriction of the orifice (*see* Fig. 2C5). The adjacent margins of ileum and colon having been accurately united, the outer margin of the colonic aperture is sutured in a similar manner to the outer margin of the ileum. A second row of
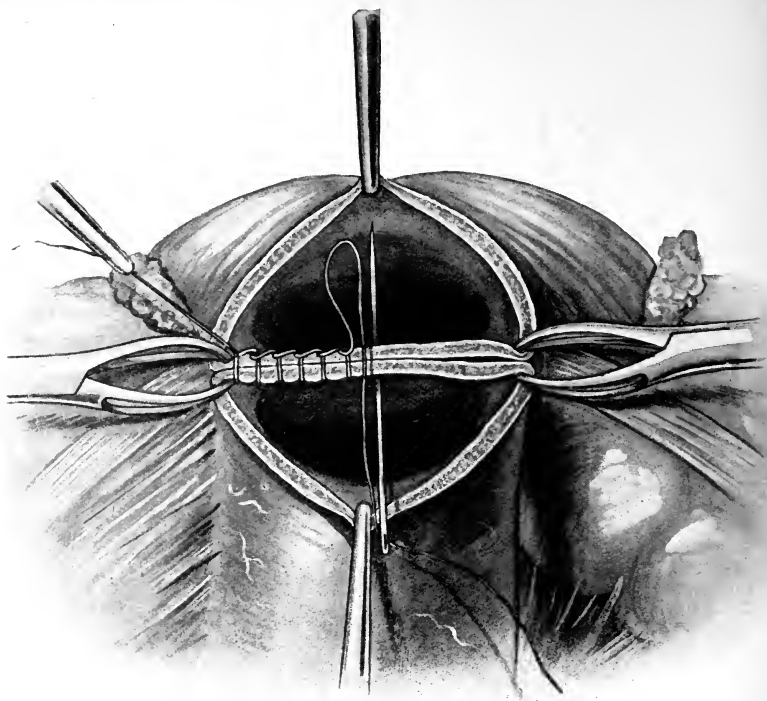
Fig. 205. Ileo-colostomy. The perforating buttonhole suture is shown. The clamps are omitted for the sake of clearness.

sutures is employed to secure more absolutely the closure of the two outer margins, and the junction is completed by an anterior continuous peritoneal suture. Silk or linen thread is used for all layers, and especial care is necessary at the angle where the mesentery is attached to the ileum (*see* Fig. 2C6).

"Lateral anastomosis, formerly practised by Sir Arbuthnot Lane, has been long abandoned by him in favour of an end-to-side union, on account of the pouching of the blind end of the ileum which was apt to occur, and which frequently caused the patient a deal of pain and discomfort.

"The anastomosis being completed, in order to withdraw the intestines from the pelvis which they enter through the interval between the mesenteries of the ileum and pelvic colon, the patient is placed in the Trendelenburg position. The gap which will be found between the mesentery of the ileum and that of the colon at the point of junction is now accurately closed by a continuous button-hole suture of silk or thread.

Neglect to close this space may lead to serious trouble, for the reason that the passage of the small intestines through the opening results in a torsion of the end of the ileum in its long axis, and the consequent partial or complete obstruction of its lumen.   An obstructive diarrhœa, which varies largely in severity, results from this condition, and this has brought discredit on the operation.

"The degree of development of the band forming the ' last kink ' is next investigated, and, if poorly represented, it is exaggerated by means of a stitch which passes round half the circumference of the bowel and then through the peritoneum lining the iliac fossa external to it.   This tends to obviate the regurgitation of material back along the descending colon.
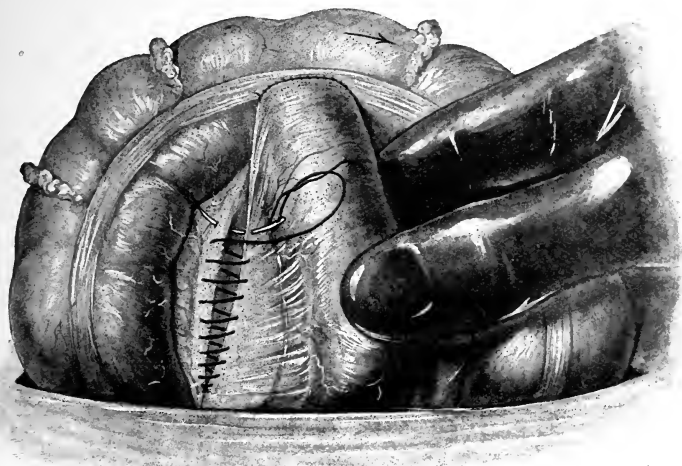
Fig. 206.   The gap between the mesenteries of the ileum and pelvic colon is being closed.   This is a most important step, for without it rotation or strangulation of the small intestine may occur.   When the suture is completed the ileum becomes isoperistaltic to the pelvic colon.

"An assistant now dilates the sphincter ani, and passes an œsophagea tube (size No. 18) up the rectum, the operator manipulating the tube from the abdomen so that it passes through the anastomotic opening into the small bowel for a distance of about twelve inches.

"The passage of this tube is facilitated by injecting several ounces of liquid paraffin up it by means of a Higginson's enema syringe.

"The abdomen is closed, and the rectal tube is fixed in position by a stitch at the anus, being left in position for five days, during which time it is allowed to drain into a receptacle at the side of the bed.

"This tube prevents and relieves any distension of the small bowel, takes all strain off the anastomosis, and adds very greatly to the post-operative comfort of the patient.

"All shock is obviated by the use of the subcutaneous saline infusion, which also prevents post-operative vomiting.   These facts probably depend upon the maintenance of a high and level arterial blood-pressure throughout the operation."

COLECTOMY

" As to whether ileo-colostomy alone is performed, or whether the colon is removed as well, depends on the mobility of the colon. Experience has shown that if the colon is fixed, ileo-colostomy is very rarely followed by regurgitation.

" If, on the other hand, it is very loose, regurgitation is not infrequently an annoying result necessitating a subsequent colectomy.

" The same preparation of the patient is necessary for colectomy as for short-circuiting, and saline axillary infusion should be carried out throughout the operation.

" The operation may be performed in one or two stages. If a two-stage operation is decided on, ileo-colostomy is performed as above, and the colon removed subsequently.

" It is, however, Sir Arbuthnot Lane's usual practice to perform the whole operation at one sitting, and in his hands this procedure is attended with practically no risk. An incision similar to that for ileo-colostomy, but somewhat more extensive, is made, and the ileum, proximal to Lane's kink, is divided as described above. The cæcum, appendix and the terminal blind portion of ileum are held up by an assistant, and the evolutionary adhesions which will be found on their outer side are divided, any vessels which are present being tied.

" The mesentery of the terminal ileum, cæcum and ascending colon is now transfixed at several points, close to the gut and tightly ligatured with stout linen thread; pressure forceps are applied between the ligatures and the gut wall, and the mesentery is divided. Great care is necessary when approaching the hepatic flexure to avoid injury to the duodenum or its blood-supply, which, however, will not occur if the ligatures are applied close to the bowel wall.

" The transverse colon is next drawn firmly forward by an assistant. In the neighbourhood of the hepatic flexure, the gastro-colic omentum and the transverse mesocolon can usually be dealt with together, being transfixed fairly close to the bowel wall and ligatured in several places. It is advisable to crush the tissue with forceps and to tie very firmly in the groove so formed, since the vessels have a great tendency to retract and troublesome bleeding may ensue. Towards the middle of the transverse colon, however, the gastro-colic omentum and the transverse mesocolon must be tied in several places, separately.

" Care must be taken to apply the ligatures close to the bowel wall, in order to avoid injury to the greater curvature of the stomach or its blood-supply.

" The splenic flexure, which must next be freed, usually provides the most difficult stage in the operation. It will be found to be firmly bound down on its outer side by evolutionary adhesions which must be carefully separated from the mesentery, the finger being passed upwards between them. Any vessels encountered are tied in the process.

" These acquired bands having been divided, the splenic flexure moves freely on its mesentery, which is then readily ligatured. The greatest care is necessary in carrying out this separation of the acquired bands from the mesentery of this part of the bowel, as otherwise the firm attachment of the gut at a great depth, the size of the vessels in this region, and their great tendency to retract, renders it a most difficult procedure should the surgeon attempt to ligature the mesentery and the acquired bands together.

"Too much stress cannot be laid on the need for tying the vessels *tightly*, and a double thickness of stout linen thread should be used for all ligatures. A failure to do so results in the retraction of the cut end of the vessel and the rapid accumulation of blood in the subperitoneal tissues.

"The descending colon is dealt with in a similar manner, evolutionary bands being first freed, when the mesentery is transfixed, tied and divided between the ligatures and the bowel wall.

"A suitable portion of pelvic colon is then grasped in one blade of a pair of curved stomach clamps, the proximal end of the divided ileum is brought across, and an end-to-side anastomosis is established as described under 'ileo-colostomy.' The anastomosis being complete, the colon is freed to within about two inches of the junction, seized with a pair of crushing forceps placed at right angles to its long axis, and tightly tied in the groove so formed. The bowel just proximal to the ligature is controlled with a pair of forceps and it is divided with the cautery between the ligature and the forceps. The colon, which is now quite free, is removed, and its ligatured distal stump is invaginated several times with a suture of silk or thread till the outer limit of the junction is reached. This invagination must be carefully and thoroughly performed in order to avoid any tendency to pouching.

"The posterior abdominal wall is next inspected and any bare areas along the beds of the ascending and descending colons are covered by drawing the peritoneum together over them. The œsophageal tube is passed as described under 'ileo-colostomy,' and the abdomen is closed."

Recently Sir Arbuthnot has adopted end to end instead of end to side union between the ileum and the pelvic colon. This shortens the operation and avoids the formation of a colic pouch.

OPERATIONS FOR APPENDICITIS. INFLAMMATION OF MECKEL'S DIVERTICULUM. PERFORATION OF TYPHOID ULCER. PERFORATION OF DIVERTICULUM OF THE COLON

OPERATIONS FOR APPENDICITIS

APPENDICITIS is most difficult to classify into different forms, for the varieties and degrees of inflammation of the appendix merge imperceptibly into each other, so that it is impossible to say that any given instance belongs entirely to one class. No one can foretell at the beginning of an attack what course the disease is going to take, for at any moment a simple appendicitis may be complicated by perforation and spreading peritonitis. The experience of a large number of operations at all stages of the disease teaches us that it is impossible to diagnose the exact condition of the appendix and peritoneum before the abdomen is opened. It also teaches us that the condition of the parts does not vary at all accurately with the duration of symptoms, although it is a fairly constant rule, that the earlier an operation is undertaken the more likely is the disease to be limited to the appendix, and the result of operation to be good. However, it is convenient to attempt a rough classification before discussing the important question of treatment.

(1) *Simple Appendicitis.* Here the inflammation is limited to the appendix. There is little or no inflammation of the peritoneal coat and no infection of the peritoneal cavity, although there may be a little serous effusion. At the most it leaves only a few adhesions with shortening of the meso-appendix. Each attack damages the appendix a little more, and leaves its lumen more obstructed by contraction or kinking, and often calculi form. Complete obstruction by impacted calculus, kinking or volvulus takes place and suppuration, gangrene or perforation supervenes.

(2) *Appendical Colic.* Here the appendix is obstructed at intervals, by kinking of its wall, or more commonly by some foreign body within. Attacks of colic lasting from a few minutes to a few hours develop, and these may be associated with nausea or vomiting. These attacks are commonly called " bilious attacks." They are rarely accompanied by a rise of temperature, for there is little or no inflammation, but the appendix is tender during the attacks : the pain is not often limited to the right iliac fossa, but is often epigastric or umbilical, probably due to reflex spasmodic contractions of the stomach or of the ileocæcal sphincter, obstructing the small intestine.

(3) *Chronic Appendicitis.* A chronic inflammation of the appendix, without fever or definite acute attack, is quite common, and causes chronic indigestion, frequently thought to be due to a nervous tempera-

ment, occupation or unsuitable diet. In more severe cases gastric or duodenal ulcer is closely simulated. There may be no pain in the right iliac region, although tenderness is generally noticed there, during the "indigestion."

(4) *Appendicitis with a Localised Abscess.*

(5) *Appendicitis with Spreading Peritonitis.*

Severe inflammation with perforation or gangrene of the appendix may cause either a localised abscess or spreading peritonitis. Usually the pus is localised at first inside or near the appendix, but it either gradually or suddenly invades more and more of the general peritoneal cavity. The sudden onset of a diffuse peritonitis is nearly always due to the rupture of an abscess, which while localised often gives few signs or symptoms. It is a mistake, unfortunately a common one, to think that a peritoneal abscess once localised always remains so. It is common for an appendical abscess to leak into the pelvis; a retrocæcal abscess often leaks downwards and inwards behind the cæcum; but it often bursts on the outer aspect of the cæcum, and travels obliquely downwards and inwards over the external aspect of the cæcum—its line of travel being plainly visible as a greyish-yellow streak. For a time the pus may be localised in the pelvis by the pressure of gas in the small intestine, rarely by frail adhesions, but as it increases in bulk it ascends into the left iliac region and later into the left loin and amongst the coils of the small intestine. It is common to find at an operation : (a) a slack abscess of some days' or a week's duration about the appendix, with thick yellow or brown offensive pus; (b) a yellow streak leading from this to a collection of sero-pus in the pelvis; (c) a free serous sterile and bactericidal effusion in the general peritoneum.

In later cases there may be sero-pus in the lower half or two-thirds of the abdomen. In a few neglected cases, the pus is everywhere, even between the liver and the diaphragm.

A high appendical abscess often travels upwards to the right kidney pouch below the liver and occasionally between the liver and diaphragm. A retrocæcal abscess sometimes causes cellulitis of the retroperitoneal tissues of the loin, which may extend upwards as far as the pancreas and duodenum, or inwards to the iliac vessels.

Appendicitis usually recurs, for each attack leaves the appendix more damaged and more liable to obstruction. Very severe attacks, especially those associated with prolonged suppuration, may occasionally destroy the appendix, or lead to the discharge of a calculus. So that recurrence is not so common after grave attacks of suppuration. It is, however, an error to think that suppuration is a safeguard against recurrence, for the only safeguard is the actual removal or destruction of the appendix—a matter not wisely left to nature—for the latter is clumsy, dangerous and uncertain in its attempts at radical treatment.

WHEN IS IT WISE TO OPERATE FOR APPENDICITIS?

Every year about two thousand deaths in England and Wales are certified to be due to appendicitis. A great many more are due to the numerous complications of this disease, without the primary cause being recognised. This waste of life is all the more lamentable because the victims of the disease are mostly young people who are otherwise healthy, and because timely operations would save the great majority. It must

be recognised, however, that early operation is often impracticable, especially for the poor and ignorant, who often grin and bear their pains in silence without recognising the seriousness of their condition, and without seeking medical aid for several days. Some patients refuse to be guided until they are seriously ill. Diagnosis is sometimes difficult, and a skilful surgeon is not always available at short notice.

A. **In the Quiescent Period, after one Attack.** Most authorities now agree that it is wise to remove the appendix after one definite attack of appendicitis unless there is some grave contra-indication to any operation. Some physicians still advise waiting until after a second attack. One attack, unfortunately, does not protect against another; on the contrary, it is a matter of common experience that it predisposes. There are no available data to show in what proportion recurrence may be expected. The necessary statistics could only be obtained by tracing the life histories of a large number of patients not submitted to operation. It used to be thought that suppuration destroyed the appendix and thus prevented recurrence, but statistics brought before the Medico-Chirurgical Society in 1905 clearly prove recurrence to have occurred in over 15 per cent. of the collected cases of drained abscesses, although most of the patients could not have been traced for more than a few years. Recurrence is certainly more frequent after simple appendicitis without suppuration.

In any case, there is no means of telling beforehand which are the lucky patients who will escape recurrence, for a perfectly healthy interval is characteristic of this disease. In fact, the patient feels and looks so well that he and his relations can scarcely believe him to be in danger, and for this reason in spite of advice an operation is too often deferred. The patient prefers to take his chance and only submits to operation during or after a recurrence.

Further, the nature of a second or subsequent attack is not certain, but the histories of a large number of cases tend to show that successive attacks usually increase in severity, and this is what is to be expected from the mechanical changes taking place in the appendix and its mesentery during and after each attack of inflammation. Early attacks are sometimes so trivial as to be forgotten, or to be only remembered as " bilious attacks," " gastritis " or " indigestion," for there may be no pain in the right iliac fossa in mild attacks, when the peritoneum is not inflamed. Sometimes, however, the very first attack is a grave one leading to spreading peritonitis. It is a common mistake to suppose that a severe attack greatly reduces the risk of peritonitis in the future, for adhesions rarely shut off the whole appendix from the peritoneal cavity; they often vanish altogether, so that the appendix may be found lying free in the abdominal cavity a month after a severe attack associated with a large swelling.

The risk of an operation undertaken by a good surgeon in the quiescent period is very small, numerous statistics showing it to be under ·5 per cent.; the risk of death from a single recurrence is far greater than this, even if it be allowed that a certain proportion up to 30 per cent. may never develop another attack. Without operation the mortality of appendicitis has been shown by physicians to be about 15 per cent.

The medical experts of insurance companies recognise the financial

risk of insuring these patients before they have had the appendix removed.[1]

A careful examination would be made to elicit any tenderness, swelling, or hardness about the region of the cæcum, which would require the case to be postponed for reconsideration at a later date after the appendix has been removed. In any case supposing there had been within the past five years a definite attack of appendicitis and, *a fortiori*, a second attack, however complete the recovery may have been, an extra five or seven years, according to the age, would be necessary to cover the risk of relapse and operation.

In cases in which the appendix had been successfully removed and a healthy scar alone remained the life would be accepted without addition.

For many reasons it seems foolish to wait for a second attack before operating. It is far better to get rid of the appendix and to be on the safe side. To wait for a second attack with the idea of operating very early in it seems to me to be wrong, because no one can foretell the circumstances under which the second attack may arise. It may be impossible to operate early enough to make the operation as safe as one undertaken in the quiescent period. The best time for operation is about two to three weeks after an attack, when the inflammatory exudations have absorbed, the intestines have assumed their normal condition, and before another attack is likely to develop. While waiting for operation the patient should avoid all but the gentlest exercise. An operation undertaken within a few days of a bad attack may be attended with considerable difficulty on account of vascular adhesions and possible pockets of pus, so that drainage has to be established in some cases, with the attendant risk of hernia.

Some attacks never do subside but become sub-acute. There are usually slight fever, wasting and anæmia with some local induration due to the presence of a small abscess with thick walls. There is nothing to gain by waiting in these cases, and much to lose from the risk of complications.

B. **For Appendical Colic.** There are many patients who have never been laid up with a definite attack of appendicitis, but who frequently suffer from colic lasting, as a rule, from a few minutes to an hour or more. The pain, which is not so severe as renal, biliary or lead colic, is associated with nausea, sometimes with vomiting, and pallor. The pain is often brought on by exercise and by food. It compels the patient to rest for a few minutes, but it soon passes off and leaves him quite well. The pulse and temperature are rarely changed, although the latter may rise to 99 or 100 soon after the attack. The pain is at first referred to the middle of the abdomen and sometimes to the cæcal region. During the attack and generally after it there is distinct local tenderness and sometimes a pencil-like swelling in the region of the appendix.

In many of these cases the pain interferes with the enjoyment of food and exercise. Upon exploring the abdomen, the appendix is the only abnormal thing found. It is rarely adherent but is kinked, or obstructed. After removal small hard fæcal masses or concretions, sometimes with nuclei of caraway seeds (as in two of my cases) or shot, and occasionally a large number of thread-worms, are found in the appendix. The attacks cease when the appendix is removed.

Care is required in the diagnosis and especial care must be taken firstly to exclude constipation, right renal and ureteral calculus ; and

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[1] Sir Richard Douglas Powell, "On the Medical Aspects of Life Insurance," *Practitioner*, April 1912, p. 526.

secondly to explore the abdomen thoroughly at the operation. Under these circumstances the removal of the appendix is strongly indicated in order to prevent graver attacks and chronic invalidism.

Example. A boy, aged 10, a patient of Dr. Bryden, of Godalming, was a thin, pale boy, who had never been very strong. Four years ago he had sunstroke and his temperature was 105°. Since then he has frequently had attacks of abdominal pain often lasting only a few minutes. While in the middle of a game he would often shout out and say, "I have got that pain again," and have to stop. He was said to suffer a good deal from indigestion. He saw a physician, who dieted him. He was sent away several times for long periods with the idea of improving his general health. The abdominal pain still persisted. It was never associated with diarrhœa, but the boy was always rather troubled with constipation. About six weeks ago Dr. Bryden saw the patient during an attack of pain, and he then noticed that the pain, which had usually been situated above the umbilicus, was more marked in the right iliac region and that there was a distinct tenderness in this neighbourhood. The patient was kept in bed for two or three days and then was quite well again. There was no elevation of temperature in the attack, which lasted about two days. Dr. Bryden diagnosed appendicitis and sent the patient to see Dr. Newton Pitt, who agreed and advised operation. The attacks of pain were sometimes associated with nausea or vomiting.

Operation. There were many enlarged glands in the lower part of the mesentery, but none of them were very large and no caseous foci could be discovered. There were no signs of tuberculous peritonitis. The appendix and cæcum were brought out into the wound. The former was unusually long and twisted upon itself at two points. Its kinking was maintained by means of fairly old peritoneal adhesions. Towards its distal end the tube was rather bulbous and of a dark colour. Its mesentery was tied with catgut and divided. The root was crushed, divided, and inverted into the cæcum in the usual way. The appendix contained four small softish calculi near its tip, which was dilated. The condition was such as often causes appendicular colic.

The boy has had no more attacks of pain in the abdomen since the operation three years ago, and his general health has improved to a remarkable degree.

C. **Chronic Appendicitis, Appendix Dyspepsia.** This may be primary but in many cases it dates from damaging acute appendicitis years ago. These patients suffer from indigestion or dyspepsia associated with anorexia, pain after food, flatulence, nausea, sometimes vomiting after food, and even hæmatemesis. As Moynihan has pointed out the symptoms may closely simulate those of chronic gastric or duodenal disease, and the condition is frequently discovered after a negative exploration for these or gall-bladder disease.

All surgeons of experience know that the appendix is often found to be diseased when the abdomen has been opened for supposed gastric or other disease, and that its removal under these circumstances is often followed by complete recovery. In some of my earlier cases the recovery has stood the test of many years. Sir Berkeley Moynihan in his graphic way drew special attention to this matter, and coined a new name, " appendix dyspepsia."

This name is not a perfect one, and " chronic appendicitis " is better from a pathological point of view, but " appendix dyspepsia " draws attention to the difficulty of diagnosis, and is, therefore, a valuable addition. Increasing surgical experience of abdominal disease teaches us to forget a good deal of the false impressions derived from examination of the dead body. A surgeon with eyes to see has amazing opportunities for seeing disease in progress, whereas the pathologist sees only the sadly altered end products. More than half the information to be derived from an examination of the appendix is lost for ever when the latter is removed. Adhesions, contracted mesentery, and kinking are all

spoilt in the removal. Apart from this it is remarkable how little change may be found in the appendix in the intervals of even quite acute appendicitis. Slight obstructions, adhesions, or fæcoliths are capable of creating a great deal of misery and "indigestion." It needs the microscope to reveal the full extent of chronic disease in some cases. A careful examination should be made in every case.

McCarty and McGrath, in an examination of five thousand appendices, found cancer of the appendix in one out of every 225 cases. Actinomycosis occasionally occurs—I have seen two—and tuberculosis is not uncommon, and is a potent source of tuberculous peritonitis.

The diagnosis of "indigestion" is getting less and less common, for accurate study and observation of symptoms and signs and thorough abdominal exploration proves "indigestion" so often due to some definite disease, especially of the stomach, gall-bladder, or appendix.

The most important point I wish to emphasise is that although an accurate diagnosis can be made in a great many cases before the abdomen is opened, absolute certainty can be attained only by a thorough exploration of the abdomen. Therefore, *abdominal operations should practically always start as explorations.* Fortunately the peritoneum allows this to be done in a few minutes, and without additional risk in the great majority of cases. A notable exception is to be found in peritonitis due to appendicitis, more or less localised to the lower abdomen, where it is neither necessary nor wise to examine the upper abdomen.

Moynihan has drawn special attention to the importance of seeking a diseased appendix when an exploration for gastric disease proves negative. The cases quoted below show the great importance of bearing this always in mind. It is just as important to examine the upper abdomen when operating in the quiescent period for supposed appendicitis, for it is not at all uncommon to find the disease in the gall-bladder or duodenum.

I have operated on four patients for duodenal ulcer whose symptoms had remained unrelieved by the removal of the appendix elsewhere through an incision too small for adequate exploration of the abdomen. In two of these, stenosis of the duodenum had developed after some years, and X-ray examination of the stomach proved the obstruction. As far as I know no one has laid stress on the liability to this mistake. Yet, it can hardly be uncommon, else I could not have come across four instances of it within the last two years. The possibility of it is sufficient to condemn the too common practice of removing the appendix through a very small incision.

Further, in many cases disease of several of the abdominal viscera may co-exist and even be dependent on each other ; for instance, it is a matter of common experience that the appendix is frequently diseased in cases of gastric or duodenal ulcer ; it may even be the primary source of sepsis. We know that chronic appendicitis profoundly alters the motor and secretory functions of the stomach and intestines and lowers the general vitality by interfering with feeding and digestion.

Again, it is not uncommon to find disease of the appendix and gall-bladder co-existing. The common association of disease of the right ovary with appendicitis is too well known to need further mention. In these cases inadequate exploration fails to reveal the whole disease, and, perhaps, even the most important part of it. The operation is naturally followed by incomplete relief, and perhaps by a secondary operation unless the patient is called a "neurotic."

Most of the failures of gastro-enterostomy are due to errors of diagnosis from inadequate exploration. The atonic dilatation of the stomach so often associated with chronic appendicitis and malnutrition was mistaken for the real disease.

CASE 1. *Chronic appendicitis simulating gastric ulcer.* Female, aged 30, has had indigestion since she was 14, and on four occasions she has had hæmatemesis. She has been laid up on many occasions for about six or seven weeks at a time, and has been treated at two country hospitals for months, being dieted and even treated by rectal feeding. She frequently vomited after taking any solid food. The diagnosis has always been " gastric ulcer." As she was getting worse, she was sent to me at Guy's for operation upon the stomach in April 1912. Examination with the X-rays negatived obstruction at the pylorus, but the stomach was low and rather dilated. There was tenderness over the epigastrium and also over the right iliac fossa.

The abdomen was opened, through the middle of the right rectus. The stomach, intestines, pancreas, pelvic viscera, and biliary apparatus were all normal except for a slight dilatation and dropping of the stomach, and an appendix which contained a calculus and was in a state of chronic inflammation with shortening of its mesentery. Since the operation the patient's health has improved a great deal. She was on full diet within a week, and she has been able to continue on this ever since without interruption, and without pain or sickness.

CASE 2. *Appendix dyspepsia simulating gall bladder disease.* Woman, aged 45. The patient has suffered a good deal from pain in the abdomen, difficulty in taking food, and much wasting. She has also had a lump in the right side of the abdomen near the liver, which was tender, and it was thought that she had enlargement of the gall-bladder probably due to stones, with possibly growth of the gall-bladder. I was asked to explore, but the prospect did not seem hopeful.

Operation on April 14, 1912, at a cottage hospital. When the patient was under the anæsthetic, the swelling in the right hypochondrium was found to be very movable. It could be pushed into the left iliac fossa and also into the left lumbar region. It was firm and oval, and was thought to be the right kidney. The urine and the act of micturition were normal. On opening the abdomen through the right rectus, the swelling proved to be the right kidney, freely movable, not enlarged, and not having a mesentery. The left kidney was also unduly movable. The stomach and duodenum were unusually low and movable, and the duodenum could easily be brought out into the wound in its first and second parts. There was no sign of an ulcer in the duodenum or stomach, and there was no pyloric obstruction. The pelvic viscera were normal except that the uterus was rather large. The appendix was lying in Morison's pouch close to the liver. It was very long and coiled. There was a narrowing near the end of it, with an enlargement beyond. The mesentery was drawn over the tip. The appendix was therefore removed. On cutting into the appendix afterwards it was found to contain pus in two places : (1) at the tip and (2) at its middle. There were also very small calculi in these situations. The patient made a rapid and excellent recovery. She was soon able to take full diet.

CASE 3. *Chronic appendicitis simulating duodenal ulcer. Operation. Recovery.* Man, aged 51, soldier, was sent to me at Guy's with the following letter : " This man has had symptoms of stomach trouble for some weeks. Apparently there is some obstruction at the pylorus. He is losing weight, and in view of his age it seems to me there may be some malignant trouble. I should be much obliged if you could do anything for him." The man had been unable to work for four months. He complained of pain in the duodenal region coming two or three hours after food, and he was tender in this region. He frequently vomited, and had hæmatemesis once. Malæna was not noticed. The rectus was rigid at its upper part. I suggested a diagnosis of duodenal ulcer, and recommended complete rest in bed on a careful diet. He did not improve, however, but got worse, and he was admitted for exploration a fortnight later.

The stomach was examined with the X-rays, with a negative result. On examining him carefully in the ward afterwards I noticed that his tenderness was most marked under the middle of the right rectus, considerably higher than the usual position of the appendix. There was no tenderness or pain in this region when I saw him at Out-Patients a fortnight earlier. The temperature was normal. There was also tenderness in the epigastrium. I had considerable doubt in my mind as to what I should find, but I thought it advisable to explore, thinking

I should probably find a duodenal ulcer, or a chronically inflamed retro-colic appendix, or both.

Operation.   The stomach and duodenum were normal, the biliary apparatus and the pancreas were also natural.   The appendix was adherent, kinked, and very long, lying behind and rather to the outer side of the cæcum and ascending colon. It was distended, and its terminal part was subacutely inflamed.   It was removed and afterwards found to be full of pus.   After a few days the patient was able to take full diet with comfort and evident enjoyment, and the general health rapidly improved.

D. **Early in the Attack.**   I firmly believe it is wise for a good surgeon to operate whenever practicable *as soon as the diagnosis of appendicitis is made or strongly suspected, and the sooner the better.*

This is the best way to avoid dangerous and troublesome complications, and it is to be remembered that appendicitis is dangerous only when the infection is allowed to spread beyond the appendix, and to give rise to serious complications which must take some time to develop, and are therefore preventable.

Early operation saves the patient a great deal of pain, misery, time and money, and relieves the medical attendant of much anxiety.   That it saves time and money is clear ; for if the patient gets over the attack, he will have to lie up again during the operation, deferred until the interval ; in this way the time of disablement and the expense are usually more than doubled.   If suppuration develops, and an operation becomes absolutely necessary late in the attack in spite of conservative treatment, the patient may be laid up for weeks or even months.

In the early stage, especially in the first attack, the operation is nearly always easy, because adhesions are few or soft, and it is nearly, if not quite, as safe as an " interval " operation.   On the other hand no one can foretell the end of any attack of appendicitis under conservative treatment.   No disease is more treacherous, for what may appear to be a mild attack frequently ends in perforative peritonitis or death.   No one can say what is going on in the appendix or peritoneum until the abdomen is opened, for it is common upon exploration for slight symptoms to find a tense gangrenous appendix.   The lull that often follows perforation is particularly deceptive, free pus being found sometimes in a supple abdomen, especially in children.

Nothing but early operation can remove the cause or set a limit to the spread of infection.

Various authorities give the mortality of appendicitis under medical treatment as from 14 to 20 per cent.   This is capable of reduction below 1 per cent. by operating at the earliest possible moment.   I have not lost a single patient operated upon within thirty-six hours ; and, as shown by Dr. Mutch,[1] there were no deaths in the operations of many surgeons within the same interval at Guy's Hospital during the four years 1906– 1909.

The mortality of my operations for acute appendicitis always undertaken as soon as I see the patients, but often very late in the attacks especially in hospital practice, is under 3 per cent., although I have refused to operate in only one case, the patient being then moribund and dying within an hour.

In a few cases there is a little suppuration in the parietal wound, unless care is taken to protect it before dealing with the inflamed appendix and peritoneal effusion.

[1] This invaluable paper is in the *Guy's Hospital Reports*, vol. xlix, p. 107.

In a good many cases, perforation of a pyloric or duodenal ulcer, inflammation of Meckel's Diverticulum, suppuration of the gall-bladder, intestinal obstruction, and ruptured tubal fœtation have been mistaken for appendicitis, and the resulting delay in treatment under the conservative regime has usually been serious. Early exploration enables the surgeon to discover his error and to treat these grave conditions while they are in a hopeful stage. Although a mistake in diagnosis is occasionally made, the abdomen is rarely opened for a supposed appendicitis without revealing some other acute disease calling for immediate surgical treatment. A blank laparotomy is better than overlooking early peritonitis. It is particularly important to remember the possibility of mistaking bacillus coli infections, especially of the right kidney, for appendicitis. The pyelitis of pregnancy is also important to bear in mind.

If a competent surgeon is not available it is better to adopt the Ochsner conservative treatment and to keep the patient at absolute rest on rectal salines with nothing by the mouth until the symptoms are abating. Above all no purgatives should be given. An operation must be undertaken if signs of localised abscess or peritonitis develop.

The following symptoms and signs strongly suggest acute appendicitis :

Pain in the middle of the abdomen sometimes well above and to the left of the navel. Later the pain settles in the right iliac region. Tenderness and rigidity in the latter situation, nausea and vomiting. Sometimes the pain and tenderness may be pelvic. Occasionally the appendix may be feelable either in the right iliac fossa or in the pelvis from the rectum or vagina. The temperature is nearly always raised, the face is frequently flushed, the tongue furred and white, and the pulse is quickened, often bounding. The pain is often so intense as to prevent sleep. The bowels are usually constipated, but there may be early diarrhœa, especially if the appendix is in the pelvis. Frequent and painful micturition also indicate a pelvic appendix. All these symptoms and signs may abate when the appendix perforates and tension is relieved. This lull in the storm deceives the unwary, but it is often followed in a few hours by signs of spreading peritonitis.

Serious Complications which can be avoided by early Operation.

Spreading Peritonitis. Frequently during an early operation, a gangrenous distended, but still shiny, appendix is discovered ready to perforate at any moment. No one can say, with any pretence of accuracy, what the condition of the appendix may be until the abdomen is opened, and to wait is bound to be disastrous in many cases. Although the appendix may perforate within twenty-four hours or less it is rare to find diffuse peritonitis at that time. A local collection of sero-pus near the appendix or in the pelvis is infinitely more common. At first the pus is not limited by any adhesions, but only by gravity and the elastic pressure of the flatulent intestines, especially the cæcum. The effusion increases more or less rapidly according to the virulence of the infection and the reaction of the peritoneum. Unlike the stomach, the appendix is too small to flood the peritoneum, therefore appendicular peritonitis is of the spreading or creeping type. Usually the extravasation from the perforated appendix is found in the right iliac fossa, often behind the cæcum. As the effusion increases it overflows into the pelvis, especially if the patient walks about. When the pelvis is full, unless limiting adhesions

have formed, the fluid rises to the left iliac fossa, left loin and amongst the coils of small intestine. In very late cases the peritonitis may be general, pus being discovered above the spleen and liver. At any stage limiting adhesions may isolate a localised abscess, but with increasing tension this may burst and flood a large part of the peritoneum. Our aim should always be to operate before the appendix perforates and thus to avoid either localised or spreading infection of the peritoneum. When the peritoneum has become infected the sooner an operation is performed the better, for the early removal of the source of infection, the appendix, and the extravasation nearly always arrests the spread of the disease.

Localised Abscess. It is much better to operate before an abscess can have time to develop. I am well aware that it is not always possible because patients often do not send for their doctor until an abscess has already formed. There are instances of subacute attacks in which patients continue to work until an abscess or peritonitis develops. The dangers of an appendical abscess are chiefly due to its liability to rupture into the peritoneum, causing spreading peritonitis. Many of the cases of peritonitis are of this grave secondary type. During the operation for appendical abscess it is often noticed how frail are the adhesions that separate the abscess from the abdominal cavity, so that any unusual exertion, or the natural increase of tension, may lead to rupture into the peritoneal cavity at any moment. In more fortunate cases the abscess may burst into the intestine, and the patient may often get well soon after this ; but it is a mistake to think that such a patient is not liable to future attacks. An abscess may burst into the urinary organs, possibly leading to cystitis and ascending suppurative nephritis. An abscess may form in the pelvis and lead to permanent damage to the important structures placed there. Residual abscesses may form at some distance, such as subdiaphragmatic abscess, which is still attended by a high mortality.

Empyema and other Pulmonary Complications. There is little room for doubt that infections of the lungs and pleura are mostly embolic, and that the liability to them increases with the duration of the appendicitis. It is a fact that these complications, and especially subdiaphragmatic abscess, are far less common in patients treated by early operation. It stands to reason that with the continued presence in the abdomen of an inflamed appendix with infected blood-vessels in communication with the portal vein, portal pyæmia is much more likely to occur than if the appendix is removed at once. Moreover, a suppurating appendix is a constant source of general blood-poisoning.

Intestinal Complications. Intestinal adhesions with secondary intestinal obstructions and also fæcal fistulæ are far more likely to develop in neglected cases. Moreover there is some evidence to show that chronic constipation in many cases dates from a severe attack of appendicitis, followed by contracting adhesions.

Hernia. By operating very early the risk of hernia is greatly reduced. for the abdomen can be completely closed in the majority of cases without endangering the life of the patient. In this respect, these early cases are in striking contrast with those for which an operation has to be performed later for spreading peritonitis or large abscess, when it is necessary to drain the abdomen for a few days at least.

E. Late and Suppurative Cases. It must be allowed that although an operation at the earliest possible moment is the safest and best

treatment for appendicitis, it is often impossible to get this done for various reasons. Poor patients often do not ask their doctor to see them until they are getting seriously ill, and have tried in vain all their homely remedies, more especially a variety of purgatives. A skilful surgeon may not be available, the diagnosis may be very doubtful, or a patient may at first refuse operation. But if the advantages of early operation were properly appreciated by those concerned it is certain that there would be less delay than there often is at the present time.

In such cases, seen after the most favourable time for operation has been allowed to pass, it is a difficult matter to decide for or against immediate operation. I. *If the signs and symptoms are subsiding*, it may seem wise to postpone the operation until about a fortnight after the attack ; but it must be remembered that appendicitis is a treacherous disease which is liable to take a bad turn at any moment, and that the patient is never safe until the appendix is removed, so that if surgical aid is not likely to be available at short notice, it is safer to operate at the first opportunity. The risk of operation in such cases is small, whereas the risk of leaving alone is uncertain. Under more favourable circumstances, such as exist in the wards of a hospital, where an operation can be performed at any moment, the risk of waiting for the quiescent period is smaller, and may seem to be justified by the low mortality of the interval operation. But in some apparently mild cases in which this course is adopted an abscess develops at any time within about fifteen days of the onset of the attack, often after all danger is supposed to be over. Then an operation has to be undertaken under less favourable circumstances. The risks of complications and of death are increased, and the difficulty of removing the appendix is greater on account of denser adhesions between vital structures, and the presence of pus. Drainage is usually necessary, and a ventral hernia is apt to follow in a few cases.

In those cases in which an abscess would not otherwise develop I do not believe that an operation at any stage of the disease increases the danger. The risk of causing a localised peritonitis to become diffuse is a very small one if proper precautions be taken to prevent it. The same is true of infection and suppuration of the abdominal wall. It is assumed, of course, that the surgeon is experienced and skilful in abdominal surgery, for what may be a safe course for one surgeon may be dangerous to advise for another. In any case, waiting involves waste of time, money, and anxiety. For these reasons I believe it is wise to recommend operation without delay in all cases of appendicitis when the circumstances are favourable, and a capable and experienced surgeon is available for what may prove to be a difficult operation. I believe that a careful operation reduces the dangers of the disease at all stages. Every surgeon knows that it is practically impossible in many cases to estimate the gravity of the patient's peril before the abdomen is opened. The duration of the disease is of little value, although it has been relied upon. The symptoms and even the signs are often deceptive. A wise and conservative physician told me that he had come painfully and slowly to the conclusion that immediate operation is the best treatment for appendicitis, at whatever stage the patient is first seen. However, different opinions prevail concerning the treatment of cases in which the patient is not getting worse, or the disease seems to be subsiding. II. *When the signs and symptoms are getting progressively worse or fail to subside in due course after three or four days, it is imperative to operate without delay in order to*

save life. It is important to mention some of the most reliable signs and symptoms which indicate that the patient is getting worse, and that an operation is urgently required to save life.

Signs and Symptoms. (1) Increasing rigidity, tenderness, and fixation of the abdominal wall. When these conditions are localised to the right iliac fossa, they usually indicate a localised abscess, but when they are spreading they indicate a spreading peritonitis.

(2) Persistence of pain and vomiting.

(3) Accelerating pulse-rate.

(4) Rapidly rising or falling temperature, especially associated with shivering; these indicate a rapid spread of the disease, and often follow the discharge of pus into the peritoneal cavity.

(5) Shifting dulness in the flanks, indicating the presence of free fluid in the abdomen, generally due to spreading peritonitis, although there may be free aseptic fluid complicating a local abscess.

(6) The presence of a tender, dull swelling in the iliac fossa, loin, or pelvis, the latter being discovered by bimanual examination.

(7) Leucocytosis, especially a rise in the proportion of polymor-phonuclear cells.

These indicate localised abscess. When the abscess is unusually high the appendix is retro-cæcal or the cæcum has failed to descend naturally. When it is situated in the pelvis the appendix is hanging over the brim. A pelvic abscess is often indicated by frequent and painful micturition, rectal tenesmus, and diarrhœa. It may not be possible to feel the localised swelling until the abdominal muscles are relaxed by an anæsthetic. The swelling may be resonant, especially in late cases, from the presence of gas in the abscess. It is foolish to wait for fluctuation, redness, or œdema before opening a localised abscess, because of the grave danger of peritoneal and vascular infection.

(8) Rapid wasting.

(9) Profuse sweating, often associated with rigors.

These indicate spreading infection and suppuration.

The peritonitis is getting grave when distension of the abdomen and tympanites begin; but operation should not be deferred so long. Sometimes patients are seen in a state of collapse and too ill for any operation. It is then wise to endeavour to revive them by warmth, continuous rectal or axillary infusion, and the injection of pituitary extract before undertaking an operation.

It may be repeated that an exploration is the only reliable means of ascertaining the nature and extent of the abdominal disease, the signs and symptoms being notoriously inadequate.

A. OPERATION IN THE QUIESCENT PERIOD

On this subject the profession owes its lead to Sir Frederick Treves, who first proposed the removal of the appendix during a quiescent period in 1877 in a paper read before the Medico-Chirurgical Society. Although the operation is usually easy it is sometimes very difficult owing to adhesions, especially when the appendix is adherent behind the ascending colon or in the pelvis.[1] An oblique incision is made

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[1] Some of the cases have been most trifling. On the other hand, in two instances I failed to remove the appendix after very persistent attempts. It is impossible to predict beforehand the features of the operation. The attacks may have been violent and numerous, and the removal of the diseased process nevertheless prove to be a mere trifle. On the

about four inches long and crossing the line joining the right anterior spine to the umbilicus at its lowest point of trisection. The aponeurosis of the external oblique is divided in the direction of its fibres. the small piece of external oblique muscle being split, also in the direction of its fibres (*see* Fig. 207). The internal oblique and transversalis muscles, which run in a direction almost at right angles to that of the skin incision, are now likewise split in the direction of their fibres and well retracted. By making the abdominal incision in this way, as described by McBurney,[1] the weakening of the abdominal wall which necessarily results from free transverse division of muscular fibres and nerves is avoided, and the tendency to subsequent ventral hernia thereby greatly diminished.
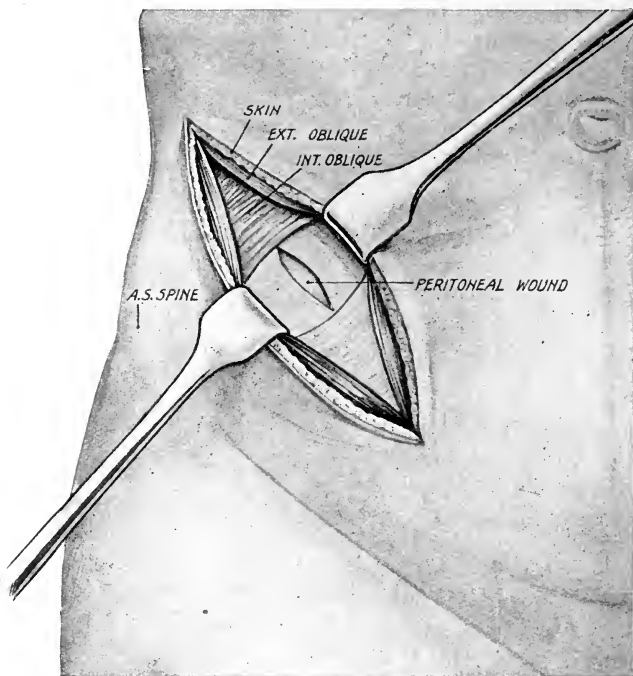
FIG. 207. Usual incision for appendicectomy. The rectus sheath is opened as a rule and the rectus muscle is drawn inwards to give ample room.

Although the amount of room obtained to work in by this method is somewhat lessened, especially in young children, and the difficulty of the operation to some extent increased, the advantage gained is so distinct that it should be adopted wherever possible, and much more room can be obtained by opening the rectus sheath and retracting the muscle. The author always does this and finds it much easier to incise the sheath at its outer border first, and to extend the incision outwards. It is easier to separate the fibres of the deep muscles neatly in this way, for the two are joined together, thin and tendinous at the outer border of the rectus. When the diagnosis is doubtful and a very extensive exploration is indicated, Battle's incision (page 426) or, better, one

contrary, some of the most difficult operations I have met with have been cases in which I had hoped, from the history of the attacks, to have encountered no complications (Treves).

[1] *Ann. of Surg.*, vol. xx, p. 38.

through the middle and inner third of the right rectus, is adopted. Hooked retractors are now used. If still more room is required, the sheath may be incised vertically upwards or downwards as required. With self-retaining retractors inserted a great deal of room can then be obtained. The peritoneum is picked up with toothed dissecting forceps at the inner part of the wound, where there are not likely to be adhesions, carefully incised and enlarged with blunt-pointed scissors until two fingers can be admitted. In the female the pelvic viscera are always palpated on account of the difficulty of diagnosis in them and of the chance of missing coexisting disease. It is common to find cystic disease of the right ovary when the appendix has been repeatedly or severely inflamed.

In both sexes two fingers, and if necessary the hand, are passed upwards to feel the gall-bladder, stomach and duodenum. The author has operated on several patients for duodenal ulcer whose symptoms had been unrelieved by the removal of the appendix elsewhere. Similarly stones in the gall-bladder have frequently been mistaken for appendicitis, but the mistake should be corrected by a proper exploration at the time of the operation. The fingers are then passed downwards and outwards to the right iliac fossa to seek the cæcum. If possible this is brought into the wound, recognised by its longitudinal bands and peculiar blue colour and delivered at once. Sometimes, it is necessary to tie off or to separate adherent omentum. When the cæcum is adherent the wound is enlarged and dilated, and the adhesions carefully separated by gauze dissection. If there is any mass suggestive of pus gauze packs are carefully placed before the adhesions are separated. The appendix is quite easy to find in the large majority of cases, but occasionally it may be very difficult to find, for it may be embedded in dense adhesions behind the cæcum and ascending colon or in the pelvis. Sometimes the cæcum is malplaced in the right hypochondrium and very rarely it lies in the left iliac fossa, with or without transposition of the colon. The end of the ileum and the anterior longitudinal bands of the cæcum are valuable guides to the root of the appendix. When the cæcum has been brought into the wound the end of a gauze roll is placed behind it in the iliac fossa and loin to collect any blood or other material that may drip into the abdomen during the separation of the appendix. The margins of the wound are protected with enveloping pads. If the adhesions are very dense or involving important structures such as the intestine, ureter, or iliac vessels, it is wise to proceed very slowly, and to separate the adhesions by wiping with moist gauze. It is safest to keep very close to the appendix and in some cases to incise its peritoneal coats and to shell it out of its coverings. When the cæcum and appendix have been delivered and packed off the appendix is removed as follows :

A strong pair of artery forceps pierces the meso-appendix in *actual contact with the cæcum and the root of the appendix* and draws a ligature through this perforation. With one of the jaws in the perforation the forceps are firmly closed on the root of the appendix without projecting beyond the free border of the latter. Another pair is applied in close contact with the first on the distal side (*see* Fig. 208). The ligature is now tied firmly round all the meso-appendix and well away from the appendix as the latter is held up by an assistant with the forceps and fingers. When passed in this way the ligature secures all the blood-vessels, including one that is often close to the root of the appendix. This small artery has been missed and fatal hæmorrhage has occurred from it. The mesentery

is divided, leaving a good stump beyond the ligature, which is divided if there is no bleeding. In some cases the meso-appendix is broad and short and has to be ligatured in sections, care being taken to secure all the vessels, including the one near the root of the appendix. In others it is easier to tie it after it has been clamped and divided in order to get a
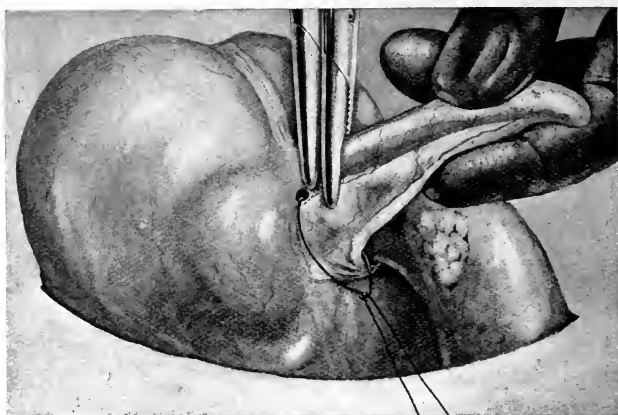
FIG. 208. Appendicectomy. The ligature is passed at the angle between the appendix and the cæcum, so that all the vessels of the appendix are secured. One strong artery forceps is on the base of the appendix and a second in close contact with the first. The appendix is divided between these with the knife, which is not used again.
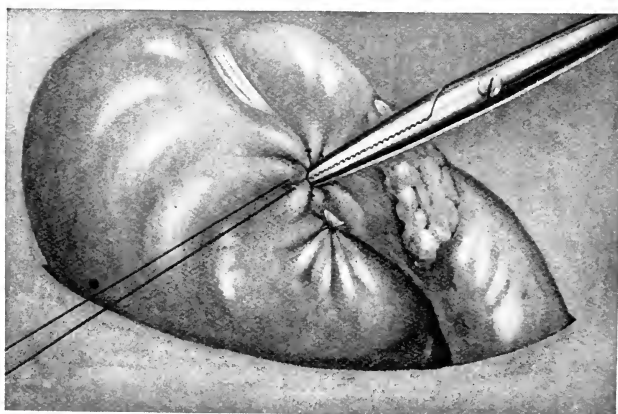
FIG. 209. Appendicectomy. The purse-string suture of fine linen thread is inserted before the appendix is removed, but after the mesentery is tied and divided. The basal forceps serve to invaginate the crushed stump, which is not tied. These forceps are not used again.

deeply-placed appendix out of the way. The appendix is severed by running the knife between the two forceps, one of which prevents leakage from the appendix and the other is turned end on and used to invaginate the crushed stump into the cæcum, as a sero-muscular purse-string suture is tied. This is inserted in the outer coats of the cæcum a quarter of an inch away from the root of the appendix (see Fig. 209). No ligature is needed

round the crushed root of the appendix if the forceps are applied early and therefore left on long enough to seal all blood-vessels. I have used this method in over five hundred cases without hæmorrhage or other complication. The knife and forceps used for the appendix are laid aside and are not used again during the operation. The packs are removed, the cæcum is returned and the wound is closed in layers with catgut. It is easier to sew the peritoneum if the latter is held well up by toothed artery forceps at each end of the incision (*see* Fig. 210). A few turns of suture are sufficient for the deep muscles. The external oblique aponeurosis needs more accurate suture. The skin and sub-
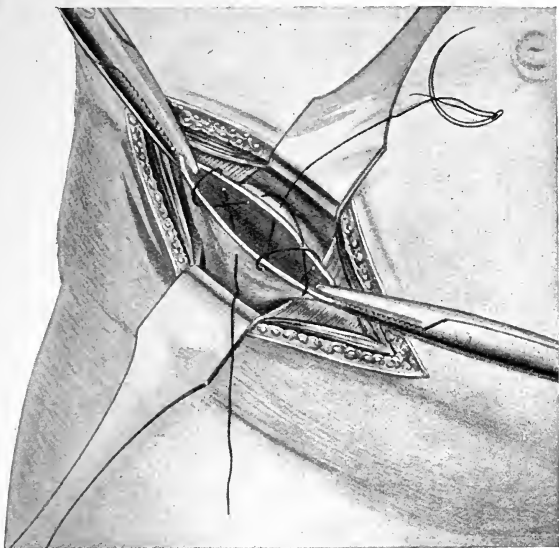
FIG. 210.   The peritoneum is brought well forward by two forceps held vertically, so that the opening can be easily closed.   Only one knot is required.

cutaneous tissues are sewn with a continuous fishing-gut suture (*see* Fig. 211).

Some surgeons prefer Battle's incision for removing the quiescent appendix; although I have used it a good deal I do not think it nearly so good as the gridiron with retraction of the rectus. When pelvic complications are anticipated a vertical incision through the rectus sheath is better, for it allows the safer and easier removal of a pelvic tumour, especially one arising in the left ovary or tube.

B. OPERATION FOR ACUTE APPENDICITIS

Unless the diagnosis is doubtful or there are indications for a very thorough exploration of the abdomen the McBurney incision is usually chosen. It is made high or low according to the position of the appendix as indicated by the situation of tenderness, rigidity and swelling, and especially by the site of the swelling, which is often palpable, perhaps for the first time, when the muscles are relaxed by the anæsthetic. When the operation is undertaken, as it should be whenever possible, before

the appendix has perforated, it does not differ from the operation during the quiescent period. It is usually very easy, especially when it is carried out in the first attack, for there are few if any troublesome adhesions. The edges of the wound are carefully enveloped during the operation.

C. OPERATION FOR APPENDICAL ABSCESS

When the operation is later and a considerable swelling can be felt, indicating *a localised abscess*, there are two alternatives.

(1) The abscess is merely opened and drained if possible without opening the general peritoneal cavity.

(2) The general peritoneum is deliberately opened first so that packs
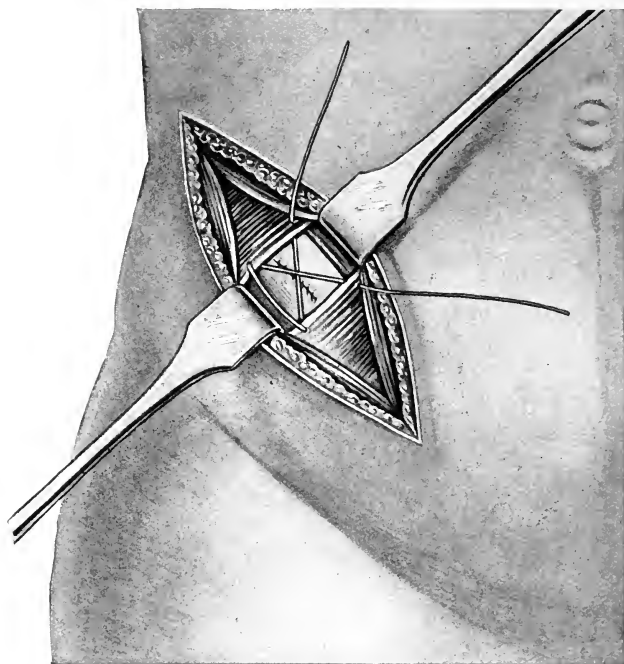
Fig. 211. Appendicectomy. Simple and effective method of bringing the deep muscles together.

may be placed before the abscess is opened. The pus is mopped away and the appendix is removed.

The relative advantages of these methods are discussed on page 427.

(1) *The Abscess is merely opened and drained.* With the abscess in the usual situation the McBurney incision is made over the outer aspect of the swelling. As the deep muscles are separated œdema of the tissues is recognised. The peritoneum is incised near the outer end of the incision and pus often escapes at once. If the peritoneal cavity is opened in front of and internal to the abscess gauze packs are carefully placed, above, internal and below the latter. A gauze roll gently paid in and secured at its outer end is the best. The pus is sought by blunt dissection at the outer part of the wound, the cæcum being displaced forwards and inwards

as a rule. A forefinger is introduced to seek the appendix or concretion, both of which if loose are removed. Care is taken to avoid breaking down adhesions and thus causing a leak of pus into the general peritoneum. The finger also ascertains the size of the abscess and its most dependent point where a counter incision may have to be made for efficient drainage. This is usually in the loin.

When the abscess is in the pelvis it is possible and wise to open it in a few cases from the rectum or vagina. This is when there is local bulging and œdema indicating that the abscess is pointing in one of these situations. A small incision through the mucous membrane is made and the abscess is opened with dressing forceps after Hilton's method. This method is not safe unless the bladder has been emptied with a catheter.

(2) *The Abscess is opened and the appendix is removed.* When the *abscess is in the usual situation* the McBurney incision with opening of the rectus sheath and retraction of the muscles usually affords enough room. When the abscess is far out and especially when it extends to the loin indicating a retro-cæcal appendix *Davis'* [1] *transverse incision* is valuable. This is usually made on a level with the anterior superior spine, but it may be placed higher or lower as required. The fibres of the external oblique aponeurosis are cut across, but those of the deep muscles are merely separated as usual. The rectus sheath is opened and the muscle drawn inwards. In difficult cases the wound is prolonged outwards as far as the anterior spine and inwards almost to the linea alba, thus giving plenty of room and a good approach to the retro-cæcal appendix. Another advantage of this incision is that it allows drainage to be established at the outer angle of the wound close to the ileum, where a hernia is not likely to develop. The rest of the wound is carefully closed in layers. *In women when the abscess is in the pelvis and the diagnosis of the cause is doubtful* Battle's [2] incision is chosen ; but when anterior drainage has to be adopted hernia is more likely to follow this. A vertical incision, four to five inches long, is made with its centre half-way between the umbilicus and the right anterior superior spine, the rectus sheath is opened an inch from its outer border, and the rectus is separated and drawn inwards. A vertical incision is made through the posterior wall of the rectus sheath and peritoneum under cover of the rectus, care being taken to avoid injuring the dorsal nerves and the deep epigastric vessels. In each case the edges of the wound are protected with pads secured to the parietal peritoneum with long clips, and gauze rolls are passed into the right loin, left iliac fossa, and lastly into the pelvis. Then the abscess is opened by gently separating the adhesions with the finger covered with moist gauze. Adherent omentum is tied and divided. All pus is mopped away most carefully before the appendix is sought. Adhesions are separated as far as necessary to display and deliver the appendix, great care being taken to avoid damaging the intestines by keeping close to the appendix. If possible the cæcum is delivered out of the wound and the appendix is removed as already described. In some cases the cæcum is thickened and friable so that inversion of the stump is not practicable. Then the latter is tied and if possible covered by the meso-appendix. In some cases it is not possible to deliver the appendix until the meso-appendix has been clamped and divided, and it is often easier to tie the mesentery after it has been

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[1] *Ann. of Surg.*, 1906, vol. i, p. 106.
[2] *Brit. Med. Journ.*, 1895, vol. ii, p. 1360.

clamped and divided so as to get the appendix out of the way. The part is thoroughly cleansed, a split rubber tube of at least half an inch internal diameter and containing a mere wick of gauze is passed into the abscess cavity either behind and to the outer side of the cæcum or over the pelvic brim as required (see Fig. 56, p. 83). When the abscess extends into the loin a counter incision is made above the iliac crest and a tube is inserted (see Fig. 54). When the abscess is in the pelvis counter drainage is in suitable cases established through the vagina in the female, but this method is rarely suitable for children or young girls. A long curved pair of forceps is introduced into the vagina, which has been previously cleansed, and forced through the posterior wall of the vagina into the pelvis. A hand in the pelvis protects the intestines and guides the forceps. The end of a long rubber tube is seized and drawn downwards until about one inch remains in the pelvis.
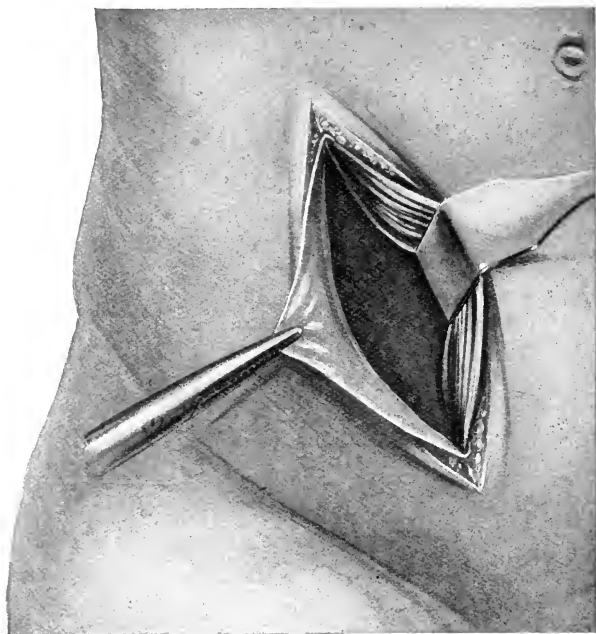
Fig. 212. Battle's incision for appendicectomy.

This part has two side-holes made in it to ensure efficient drainage. The lower end is fixed to the vulva by suture (see Fig. 55). The tube is kept in for four days. This form of pelvic drainage hastens the recovery and does no harm. It often allows the abdominal wound to be closed, and the risk of hernia to be thus avoided. When the tubes have been placed the packs are withdrawn and the wound closed as far as is consistent with efficient drainage. Usually the peritoneum is closed with catgut, and the muscles or aponeurosis are also sewn with catgut unless there are reasons for hurry. Then all the layers down to the peritoneum are approximated with stout fishing-gut sutures.

IS IT WISE TO REMOVE THE APPENDIX WHEN THERE IS A LOCALISED ABSCESS ?

It is a common error to believe that the appendix is destroyed by a localised abscess, and therefore that it is unnecessary to remove it (*a*) either at the time of opening the abscess or (*b*) at a subsequent date. When the abscess is a large one of long duration the chance of the destruction of the appendix is greater than when it is small and of short duration. When a calculus is discharged some presume that the power of the appendix for evil is abolished.   In 1905 there was a discussion upon this subject before the Medico-Chirurgical Society, when the statistics of a large number of cases were collected from various hospitals and from the private practice of several surgeons.   Sir Frederick Treves then stated that recurrence of symptoms occurred in about 17 per cent. of the cases in which the abscess was merely drained.   Sir Alfred Pearce Gould gave a lower estimate of 10 per cent.   It is probable that recurrence takes place in a higher proportion than was calculated by these and other authorities, for their calculations necessarily had a comparatively short time limit. This is especially important to bear in mind, as most of the subjects of appendicitis are young people with a fairly long expectation of life.   If the life histories of all these patients could be followed up to the ends, it is probable that recurrence would be found in at least 25 per cent.   It will be noticed that in one of the cases illustrating this paper the symptoms came on after nine years of complete immunity from symptoms.   Judging from statistics of recurrences and from the findings at radical operations undertaken in the interval following abscess, operations for ventral hernia following long-continued drainage, and especially from the findings at operations for abscess, it is a rare event for the appendix to be completely destroyed by suppuration, and nothing short of this is sure to prevent recurrence of inflammation.   Further, it is rare for *all* the appendix to lie in the abscess cavity, even when it is retro-cæcal.   As a rule some part of it is free in the peritoneal cavity.   For instance, it is common to find a perforation over a calculus near the tip of the appendix when the base is covered with comparatively healthy peritoneum in the general peritoneal cavity.   Upon this important fact depends the risk of peritonitis at future attacks.   Sloughing near the base of the appendix may lead to stricture with gradual distension of the terminal part, leading to future attacks. Case 1 is a good illustration of this.

CASE 1.   *Appendical abscess drained.   Recurrence within three months. Secondary operation.*   A young lady, aged 15, had an appendicular abscess opened on the sixth day of an attack in November 1907.   Before Christmas she was able to return home quite well.   At the middle of January 1908 she had several attacks of pain in the right iliac fossa, associated with vomiting and slight fever.   It was therefore decided to remove the appendix.

Operation.   The fibres of the oblique muscles were separated.   The cæcum was found but could not be delivered owing to extensive and firm adhesions.   The appendix was found behind the cæcum and ascending colon.   It was still inflamed. Its base was strictured, probably at the site of the previous perforation.   The distal part of the appendix was greatly distended and contained muco-pus.   The appendix was removed in the usual way and the abdomen closed.   The patient has remained well for seven years.

(*a*) Until recent years it was not considered safe to seek the appendix in the wall of the abscess, and it was regarded a triumph if the abscess could be drained without opening the peritoneum.   A great many lives

have been saved by this course of treatment, and it is still the best plan to adopt *for some patients who are very ill* and by surgeons who are inexperienced in this special work. The removal of the appendix must add a little to the length of the operation, but with a skilful surgeon this addition is rarely sufficient to be so detrimental as leaving a diseased appendix in the abdomen. The risk of setting up diffuse peritonitis by removing the appendix is very small if proper precautions be taken. It is essential to recognise that the risk is not in opening the peritoneum, but *in setting free and leaving infective material in the peritoneal cavity.* The removal of the appendix entails opening the peritoneal cavity in the majority of these cases, for some part of the diseased appendix usually faces this cavity. This accounts for the known danger of seeking the appendix from within the abscess, especially when all the pus has not been mopped away. Therefore it is evidently necessary to take due precautions against the possibility of *overlooking a leak into the peritoneum,* before or during the removal of the appendix. There is only one certain way of preventing this catastrophe, and this is *by first deliberately opening the peritoneum internal to the abscess, and packing off carefully before the abscess is opened.* Whenever suppuration is suspected, three rolls of dry aseptic gauze are passed in order to the left iliac region, to the right loin and to the pelvis. It is important to place the two first packs before the pelvis is invaded, because unsuspected pus is frequently found in the pelvis. The end of each roll is clipped to the towels. The parietes are also protected with fixed gauze pads, and then the abscess is opened. All the pus is mopped away, and when the cavity is dry the appendix is sought and removed, hindering adhesions being broken down if necessary. A tube containing a mere wick of gauze is placed below and outside the cæcum, the packs are removed, and the wound is partly but not tightly closed around the tube, which is not removed for four days, although the wick is changed. For the better drainage of a retro-cæcal abscess a tube is sometimes placed in a stab wound from the loin, and similarly vaginal or rectal drainage is adopted for some late pelvic abscesses, the anterior wound being closed. Occasionally an abscess, especially a very large one, is opened before the peritoneum is opened and therefore before the packs can be placed. Under these circumstances the appendix may be sought from within the abscess after taking the precaution of carefully mopping away all pus and blood ; but this is neither so safe nor so easy as the method already recommended. It is not so safe because without opening the peritoneal cavity freely a pelvic abscess or even a spreading peritonitis may be overlooked, or infective material may leak into the pelvis through a small opening made in the wall of the abscess during the removal of the appendix. It is not so easy because without separating adhesions and exposing the peritoneal surface of the cæcum, it is not easy either to identify and deliver the cæcum or to trace its longitudinal bands to the appendix. For these reasons, after mopping the pus away, I separate the adhesions *in front* and open the peritoneum and place packs before seeking the appendix. The disadvantages of leaving the appendix are considerable. I believe that complications are more likely when it is left, especially secondary abscesses, peritonitis, pulmonary complications and portal pyæmia. Intestinal obstruction and fæcal fistula also seem to be more common. The long-continued drainage which is often necessary favours the formation of ventral hernia. Convalescence is often prolonged by sinuses and chronic septic absorption. Moreover time,

money, and opportunities are wasted by relapse, recurrence, or the need of secondary operations either for abscess, peritonitis or for the removal of the appendix in the quiescent period.   Case 2 is an excellent illustration of this.

Case 2.   *Retro-cœcal appendix.   Diffuse peritonitis twice.   Several abscesses and empyema within ten months.   Appendix removed during last attack of peritonitis. Recovery.*   A young man, aged 21.

History.   About February 1911 he was operated upon for appendicitis with peritonitis, being very ill at the time, and the surgeon hoped that the appendix had sloughed off.   The abdomen was drained.   About April 1911 he had another abscess over the left iliac fossa drained.   He had a sinus for a long time.   He also had an empyema at the left base, which was drained posteriorly.   He had another abscess opened in July 1911.   Since September 1911 he has been very much better, has gained a good deal of weight, and has been doing his ordinary work without difficulty except that he has had a little indigestion for the last few weeks, and for five days consecutively he has vomited after dinner and has had a good deal of pain in the *epigastrium* immediately after eating.   The bowels have acted fairly well.   He took a dose of castor oil on the morning of November 21, 1911. He was seized with violent pain in the lower part of the abdomen on the right side at 6 P.M. on that day.   He took some brandy, but this did not relieve the pain. I saw him for the first time at 8.30 P.M. on the 22nd.   His abdomen was rigid and was very tender in the right lower portion, and there was a little redness and œdema of the scars over the appendicular region.   There was also tenderness in the left iliac fossa.   The pulse was about 116, respiration 26, and temperature 101°.

Operation.   I opened the abdomen through the right rectus internal to the old scars.   Before the abdomen was opened I could feel a mass in the loin.   Directly the abdomen was opened blood-stained pus escaped.   This was very offensive. Packs were passed to the flanks and pelvis in order.   The pelvis contained a fair amount of pus and lymph, and there were a great many adhesions between the coils of small intestine and between them and the anterior abdominal wall.   The cæcum was unusually high, and the appendix could not be found at first, but a grey area indicated its situation.   After some dissection it was found behind the cæcum and colon extending vertically upwards for six inches.   Its distal two-thirds were in good condition, but its basal portion had recently perforated over a calculus, and was very adherent and difficult to isolate.   It was removed and its base invaginated in the usual way, but its mesentery could not be identified and tied owing to dense adhesions.   There was a good deal of oozing of blood.   The packs were withdrawn.   Three drains were inserted, one of gauze extending up behind the ascending colon, and two tubes containing wicks of gauze, one to the stump of the appendix, and one just over the brim of the pelvis.   The peritoneum was partly closed with catgut, and the rest of the wound above the drains sewn with mass salmongut sutures.   The operation was a difficult one owing to the amount of adhesion, and the difficulty of identifying the parts.   A few days later an abscess was opened through the old empyema scar.   The patient made a good recovery.

The removal of the appendix at the first attack or soon afterwards would have saved this patient a great deal of trouble.   I did not see him until just before the last operation.   The diagnosis had been difficult, owing to the vagueness of the early abdominal symptoms.   Pneumothorax and subdiaphragmatic abscess had been suggested.   The writer has had to operate in several similar cases.   One patient, a boy aged 12, had had five operations for appendicitis in less than a year.   Conscious of the above-mentioned disadvantages and dangers, I decided, some five years ago, not to leave the appendix without some very good reason, such as the grave condition of the patient, and since then I have left it in only three very late cases.   Death and complications have been fewer since I adopted this plan.   It is necessary to insist that the safety of the method depends on carefully carrying out in every case the precautions already mentioned.   When such precautions cannot be taken it is better not to attempt to remove the appendix at the primary operation, but to be

content with drainage. A close watch must then be kept for pelvic and subdiaphragmatic abscesses.

(b) *The removal of the appendix at a subsequent date.* In a certain number of cases a secondary operation has to be undertaken, because a sinus or even a fistula refuses to heal. About a year ago a lady was sent to me for fæcal fistula nine months after a drainage operation. I found and closed a cæcal fistula, and at the same time removed a large ballooned appendix, all of which, except the strictured base, was lying free in the peritoneal cavity. I have removed similar appendices during operations for ventral hernia, and for intestinal obstruction due to peritoneal bands extending from the appendix.

In other cases there are early relapses or the symptoms never subside ; an induration persists in the iliac fossa, with pain and stiffness of the right thigh. Other patients suffer from chronic dyspepsia due to chronic appendicitis. Under these circumstances the patient welcomes or even urges a radical operation.

There is some difficulty and anxiety in advising a large group of patients who seem to be quite well. Unless there is some contra-indication to an operation, such as serious visceral disease, I think we ought to tell the patient the chance of recurrence, and to point out that recurrent attacks are apt to be very deceptive, and sometimes very dangerous. It is for the patient to choose between the slight known risk of a radical operation and the unknown risk of recurrence of a disease, which carries with it a high mortality. When several years have elapsed without symptoms, the patient may reasonably decide to take his chance. The following is an instance of a late recurrence.

CASE 3. *Acute appendicitis nine years after drainage of appendicular abscess.* Nine years ago a lady, aged 52, had a large appendical abscess drained. The appendix was not removed. The sinus went on draining for about six months and she gradually made a good recovery and remained very well until quite lately, when she has had a little indigestion. On April 4, 1912, she was going abroad, and was actually dressed ready to start, when she was seized with very severe pain in the abdomen and fainted. Very reluctantly she had to abandon her trip. She had very great pain that day and vomited a good deal. She did not sleep that night, and on the 5th the symptoms were the same, only she was a little better. Her temperature did not go up to more than 100·4 and the pulse was never higher than 100, but the abdomen was full·and rigid in the lower and right part. The patient looked ill and her medical attendant became anxious and asked me to see her on the 6th, at·4.30 P.M. She said she was a good deal better, but I thought this due to perforation of the appendix giving relief of tension and of pain. I strongly advised an operation and this was done just fifty-five hours after the onset of the attack.

Operation. An incision was made *internal to the old scar*, which was rather weak but not herniated. The lower part of the rectus was displaced inwards and the peritoneum opened. There was no pus free in the cavity. After passing packs into the flanks and pelvis the appendix was sought. The cæcum was very adherent to the old wound, so that it was fortunate that the exploration was internal to the old one. The appendix was lying behind the cæcum. In separating it a few drachms of pus escaped on to the pack. The appendix was small, thick-walled, rigid and fibrous, possessing very little lumen. It was acutely inflamed. Its base was crushed, divided between two artery forceps, and then invaginated by a purse-string suture. Its mesentery was tied. The abdomen was closed in layers and a small rubber tube was placed in the superficial wound for temporary drainage. Catgut was used for the appendix, mesentery and muscles, and salmongut interrupted sutures for the skin. A rectal saline was given immediately after the operation. The patient had an attack of diarrhœa and vomiting after the operation which gave rise to some anxiety, but the pulse and temperature were normal, and the attack soon subsided and the patient made a good recovery.

When an abscess has discharged spontaneously into the bowel, vagina, bladder, or on to the surface, it offers no greater safeguard against recurrence.

Conclusion. (1) If an experienced and capable surgeon is available and the condition of the patient is not grave, it is the best thing for the patient to have the appendix removed with due precautions at the time the abscess is opened.

(2) When simple drainage has been adopted a radical operation is to be recommended later unless the patient is either very old or unfit for operation on account of serious visceral disease.

OPERATION FOR SPREADING PERITONITIS DUE TO APPENDICITIS

Unless it is fairly certain that the appendix is the source of the peritonitis it is better to make a vertical incision near the middle line. Otherwise either the McBurney or Battle incision is chosen and is placed high or low according to the indications before and after the anæsthetic is administered. The edges of the wound are protected. When the peritoneum is opened pus at once escapes. Rolls of gauze are passed into each loin and lastly into the pelvis. These absorb the collections of fluid while the appendix is sought and removed. The end of each roll is clipped to the towels so that none may be lost. In every case the pelvis is explored, for otherwise a collection of pus may be overlooked. Unless there have been previous attacks or the present one is due to the rupture of a localised abscess, it is easy to find the cæcum and to remove the appendix. In early cases the appendix is treated as already described. In grave cases it and its mesentery are simply but separately clamped, tied, and divided. The pelvic peritoneum is cleaned with moist gauze rolls, and the packs are removed. As a rule drainage is established, a split rubber tube containing a wick of gauze being passed behind the cæcum or into the pelvis. In severe cases another tube is passed towards the pelvis or left loin through a similar but quite small gridiron incision over the left iliac fossa ; but as a rule this is unnecessary. In early cases with only turbid serum in the peritoneum and no pus in the pelvis the abdomen is closed in layers, but it requires considerable judgment to know the cases in which this can be done with safety and advantage. In doubtful cases it is safer to leave a drain, and in many it is desirable to leave a small tube in the parietal wound on account of the risk of cellulitis, especially in old and stout people. The peritoneum can overcome an infection, which causes trouble in the cellular tissues of the abdominal wall.

When a tube is inserted in the abdomen the peritoneum is partly closed with catgut and the remaining layers are approximated with stout fishing-gut passing through all the layers except the peritoneum.

The whole operation should be done speedily yet gently and carefully, and it rarely occupies more than twenty minutes, often only about ten minutes. The result depends much upon the skill of the operator, and upon the care bestowed upon the after treatment (*see* Chap. I.).

Complications after Operation. Those common to all abdominal operations have been discussed in Chap. I., and some of those of appendicitis have been mentioned at page 416. With earlier operation they are becoming far less common.

(a) *After interval operations.* Thrombosis, especially of the left iliac veins, or pulmonary embolism occasionally occurs, and in spite of all care with the anæsthetic and asepsis these are not always preventable, especially in patients who are anæmic and in poor health following severe attacks of appendicitis.

(b) *Of suppurative appendicitis.*

(1) Intestinal obstruction from kinking and paralytic distension or from peritoneal bands constricting the lower ileum.

(2) Continued peritonitis and septicæmia.

(3) Portal pyæmia.

(4) Pulmonary complications such as empyema, pleurisy and pneumonia.

(5) Secondary abscesses, especially pelvic and subdiaphragmatic.

(6) Fæcal fistula, especially from the ileum or from the cæcum, at or near the stump of the appendix.

An abscess may burst into the rectum, bladder or vagina and sometimes a fistula results.

(7) Thrombosis of the iliac, femoral or saphena veins. Pylephlebitis.

(8) Pulmonary embolism.

Mr. Lett[1] records the complications of one thousand operations for appendicitis as follows : fæcal fistula 49, thrombosis of femoral vein 12, intestinal obstruction 10, broncho-pneumonia 17, pleurisy with effusion 14, pleurisy 2, empyema 7, acute bronchitis 4, pulmonary embolism 1, parotiditis 4, pylephlebitis 4, residual abscess 11, secondary abscess 12.

INFLAMMATION AND PERFORATION OF MECKEL'S DIVERTICULUM

This may closely simulate appendicitis and intestinal obstruction, and may result in (a) simple catarrhal inflammation without infection of the peritoneum ; (b) formation of a localised abscess ; or (c) perforation or gangrene leading to diffuse suppurative peritonitis, which is relatively more common and more serious than the peritonitis arising from the vermiform appendix. The cause of the trouble is rarely diagnosed before an operation is undertaken for the relief of intestinal obstruction or for the treatment of peritonitis, generally considered to be of appendical origin. This condition is more fatal than appendicitis for several reasons : the greater size, larger lumen of the diverticulum and free communication with the bowel favour fæcal extravasation from a perforation ; the greater freedom and more median position of this unusual appendage are also unfortunate for localisation of inflammatory products and extravasations arising from it ; and, lastly, intestinal obstruction often co-exists, and a kink or volvulus at the base of the diverticulum may cause obstruction of both it and the small intestine at the same time. A gangrenous or perforative inflammation of the obstructed diverticulum is likely to occur and to lead to peritonitis in a few hours.

Gibbon,[2] Clinton,[3] Dineur,[4] Oliver Ashe,[5] Roberts,[6] Oliver Smith,[7] and others record interesting cases of this kind. Smith quotes Blanc's thesis to the effect that of twelve cases of acute inflammatory and perfora-

[1] *Lancet*, vol. i, p. 539.
[2] *Amer. Journ. Med. Sci.*, November 1903.
[3] *Buffalo Med. Journ.*, June 1904.
[4] *Journ. Méd. de Bruxelles*, November 5, 1903.
[5] *Lancet*, August 29, 1903.
[6] *Ann. of Surg.*, July 1906.
[7] *Ann. of Surg.*, 1904, vol. xl, p. 744.

tive diseases of the diverticulum eight died and three recovered after operation, the result being uncertain in the other cases.

Halstead [1] has related two fatal cases of perforation occurring during the second and fourth weeks of typhoid fever; he also mentions two other fatal cases reported by Galton and Boinet, and he points out that perforation is very likely to occur at the fundus, because the muscular wall may be deficient there. Tuberculous ulceration with perforation may also occur, although it is infinitely rare as compared with inflammation following sudden or chronic obstruction and the formation of fæcal concretions.

The treatment of this rare disease should be carried out along the lines laid down for appendicitis and its complications, for which the operation will have been undertaken as a rule. The diverticulum should be removed and its base tied and inverted by purse-string or Lembert's sutures; but this may not be always possible, owing to the constriction, volvulus or gangrene of the small intestine, which may call for resection or primary drainage with secondary resection in bad cases with paralytic distension existing or threatening.

PERFORATION OF TYPHOID ULCER

The diagnosis of this accident, which occurs in about 2·5 to 4·9 per cent. of all cases of enterica, is very important. Perforation accounts for at least a third of the deaths from typhoid fever.[2]

Unfortunately it is very difficult to arrive at a diagnosis, for few of the classical symptoms and signs of perforation present themselves when perforation occurs during the depressed and almost moribund stage of the fever; a number of perforations are therefore not suspected until they are discovered at the autopsy. In others the diagnosis is only made when signs of peritonitis become evident, and an operation offers but a forlorn hope; peritonitis may occur without perforation.

Perforation practically implies certain death, although rare and undoubted cases of spontaneous recovery have been recorded. Goodall relates one interesting case of this kind; the recovery occurred in one out of 68 cases which were not treated by operation, giving a rate of recovery of 1·4 per cent. for this series, and this is unduly hopeful.

The results of operation for this condition during recent years have made a steady improvement. In a list of 83 cases which Keen [3] gives, there were 16 recoveries; 19·2 per cent. of the operations, therefore, were successful.

Harte and Ashhurst [4] collected the records of 362 cases treated by operation, and found that 26 per cent. of these had recovered, but these figures are far too favourable, for all the successful cases are published hurriedly, whereas the records of failures are buried in oblivion. Goodall [5] mentions 49 *consecutive* operations at the Metropolitan Fever Hospitals, with four recoveries, or 8 per cent.

Elsberg [6] records 25 cases of typhoid perforation *in children*, with 16

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[1] *Med. Record*, November 29, 1902.
[2] Harte and Ashhurst, *Ann. of Surg.*, 1904, vol. xxxix, p. 8; Goodall, *Lancet*, vol. ii, 1904, p. 9.
[3] *Surgical Complications and Sequelæ of Typhoid Fever*, 1898.
[4] *Loc. cit.*   [5] *Loc. cit.*
[6] *Ann. of Surg.*, July 1903.

recoveries ; the prognosis is known to be much better in children. Jobson and Gitting [1] record 22 recoveries in 44 children.

Woolsey [2] records 17 consecutive hospital cases, with a mortality of 76·4 per cent., and F. T. Stewart [3] publishes 8 cases, with 2 recoveries. Meakins [4] records 1230 cases of typhoid, with 32 perforations, 20 operations, and 5 recoveries. It is not probable that the percentage of recovery in *any series of a large number of consecutive cases* will be above 30 for many years to come, but this would be a brilliant success for a condition which is practically certain to be fatal unless an operation is done.

This improvement is doubtless largely due to earlier diagnosis of the condition, and therefore earlier operation ; and as the feasibility of the operation becomes more fully recognised by physicians and surgeons alike, a still greater proportion of successes will no doubt be obtained. Keen may be quoted on this point ; he says, " When once the physicians are not only on the alert to observe the symptoms of perforation, but when the knowledge that perforation of the bowel can be remedied by surgical means has permeated the profession, so that the instant that perforation takes place the surgeon will be called upon, and, if the case be suitable, will operate, we shall find unquestionably a much larger percentage of cures than have thus far been reported." But, although earlier diagnosis will do much to render these cases more hopeful, it must not be forgotten that many of them will still be practically hopeless from the first, both on account of the serious condition of the patient and of the technical difficulties which the surgeon will have to face.

Diagnosis. The sudden onset of acute pain, especially in the right lower quadrant of the abdomen, accompanied by unusual tenderness and rigidity, strongly suggests the occurrence of perforation. Shivering is also an early sign, on which Goodall lays stress. Collapse of any marked degree is unusual, and its absence should not be allowed to mislead. The affected loop of bowel may lie in the pelvis, where its perforation may cause pelvic peritonitis with vesical and rectal symptoms, such as frequent and painful micturition, rectal tenesmus and excessive tenderness on rectal examination. A blood count is of no certain value except that the absence of any marked decrease in the number of red corpuscles indicates that the symptoms are not due to hidden intestinal hæmorrhage. Leucocytosis does not develop soon enough to be of value. An obliteration of the liver dulness if it occurs when the abdomen is flat may be of importance in confirming the diagnosis in a few cases, but its absence is not to be depended on. It should not be forgotten, however, that symptoms of perforative peritonitis may come on insidiously in typhoid fever, and that a patient may die with unsuspected general suppurative peritonitis ; also that the collapse and exhaustion of the third week may simulate perforation. Further, it is not uncommon for the signs of perforation to subside for a time after the initial sharp onset of pain. This stage is very deceptive. Appendicitis occurring during enteric fever is difficult to distinguish from perforation of an ulcer. The writer has successfully removed the appendix in two cases of this kind.

Every effort must be made to arrive at an early diagnosis, however, and for this reason a surgeon should be asked to see the case when any suspicion arises, so that he may share the responsibility and operate

[1] *Amer. Journ. Med. Sci.*, November 1909. [2] *Ann. of Surg.*, 1906, vol. i, p. 652.
[3] *Amer. Journ. of Med. Sci.*, May 1904. [4] *Montreal Med. Journ.*, October 1905.

without· delay if necessary. When there is a strong suspicion of the occurrence of a perforation, an exploration should be undertaken and carried out as rapidly as possible if a capable surgeon is available.. A blank exploration under favourable circumstances is not necessarily a very serious thing. Harte and Ashhurst give the following account of operations of this kind :

" Of 26 such operations in which no peritoneal lesions were found, 16 patients eventually recovered ; only 10 died—a mortality of 38·46 per cent. Of the nine fatal cases in which the duration of life after operation is known, only three died in less than twelve hours. Of these three, one (Finney) died from pulmonary embolism following iliac thrombosis ; the second (J. F. Mitchell) had had severe hematemesis and enterorrhagia shortly before operation, and was in a very precarious condition ; while in the third case (Le Conte), in which the patient lived nearly seven hours after operation, the toxæmic state previously existing persisted without material change until death. In these three cases local anæsthesia was used, and in no way can the exploratory incision be held to have had any connection with the fatal termination."

The success of treatment depends very much upon early operation, without waiting for reaction from any collapse that may be present. To avoid delay in getting consent from the relations it is wise to explain to the latter, early in the disease, the chances and dangers of perforation and to get their consent to immediate operation if perforation takes place. Armstrong [1] found that ten operations performed during the first twelve hours were followed by four recoveries, whereas the same number of operations done during the second twelve hours were followed by only one recovery. All those operated upon after twenty-four hours died. Harte and Ashhurst's figures do not show the same striking effect of delay :

ANALYSIS ACCORDING TO DURATION OF PERFORATION BEFORE OPERATION.

Cases operated on.					Recovered.	Died.	Total.	Mortality.
First 12 hours after perforation	.	.	.	35	95	130	73·0 %
Second ,, ,, ,,	.	.	.	22	62	84	73·8 %
Third ,, ,, ,,	.	.	.	2	29	31	93·5 %
Over 36 hours ,, ,,	.	.	.	18	37	55	67·2 %

(Harte and Ashhurst)

and it is to be noticéd.that operations performed after thirty-six hours gave a mortality of only 67·2 per cent., but these cases were the few mild cases of slight and localised extravasation that had survived long enough to require an operation at this late period. Armstrong [2] reports seventy-eight operations with twenty-four (or 30·7 per cent.) recoveries.

The cases may be divided into two different classes—the first, in which perforation takes place during the height of a severe attack ; the second, in which the perforation occurs during convalescence or a mild relapse. In the former class the prospect is almost hopeless from the first ; in the latter, however, there is a considerable chance of success.

Two anatomical points should be remembered in connection with operation. (1) *That the perforation nearly always occurs in the last few feet of the ileum.* According to Keen, it is in the ileum in 81·4 per cent. Harte and Ashhurst found that in 140 cases out of 190 the perforation

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[1] *Ann. of Surg.*, November 1902. [2] *Brit. Med. Journ.*, October 29, 1910.

was within a foot of the cæcum, and in only four was it more than a yard away from the ileocæcal valve. The appendix was found perforated in eight cases, and Meckel's diverticulum in three. The large intestine may be perforated in rare cases.

(2) *That more than one perforation may be present.* In Keen's list there were two or more perforations in 16·7 per cent. Harte and Ashhurst found that more than one perforation had occurred in 12 per cent. of 271 cases.[1] In a man aged 38 Wroth[2] found four perforations in the ileum. The patient recovered after a lateral anastomosis for fæcal fistula.

Operation. Owing to the feeble condition of the patient this calls for speedy, gentle and accurate work. It is carried out on the same lines as those described for acute appendicitis with peritonitis. Sometimes local or spinal anæsthesia is adopted.[3] Battle's incision is the most suitable and gives good access to the lower ileum and cæcum. When the peritoneum is opened packs are placed to soak up the extravasation and the cæcum is taken as a guide to the lower end of the ileum, and the latter is followed up. Adherent lymph or lines of intense inflammation often indicate a perforation and sometimes an escape of gas or liquid fæces. As soon as a perforation is found, the coil is brought outside and surrounded with warm moist pads. A small perforation or a threatening one is invaginated with a sero-muscular purse-string suture of fine linen thread. A large opening is closed with a continuous Connell reinforced by a continuous Cushing suture. Occasionally an omental graft may be used to plug and close a large perforation with friable walls.[4] In some cases an enterostomy is performed : a perforated appendix or Meckel's diverticulum is removed.

Occasionally it is not possible either to find or close a perforation, but if free drainage is provided the patient will have a better chance of recovery than if the operation is unduly prolonged by vain attempts to close the opening or to bring it to the surface, or worse still resect a portion of the bowel. As a rule the patient is too feeble to stand such heroic and prolonged operations. Moreover, the fæcal fistula soon closes spontaneously if the bowel is not fixed to the wound but is left among neighbouring coils, with a tube containing a gauze wick reaching down to the perforation. With multiple perforations enterostomy is sometimes necessary.

The peritoneum is cleansed with gauze rolls passed into the pelvis and flanks and left there to soak up the extravasation while the perforation is sought and closed. This is safer and speedier than irrigation. The packs are removed and the wound is closed either partly or completely. Usually drainage is required by means of a cigarette drain passed into the pelvis. When the extravasation is local and early the wound is completely closed.

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[1] *Loc. cit.*   [2] *Ann. of Surg.*, November 1909.
[3] Eucaine or cocaine local anæsthesia may be used in some cases. (*a*) For exploratory purposes in cases of grave doubt, a small incision may be made, and the lower three or four feet of the ileum rapidly examined, and a rubber tube passed into the pelvis and aspirated to find if any free fluid is present there ; (*b*) for bad cases, where a general anæsthetic may be considered too hazardous. Dr. G. L. Hays (*Amer. Med.*, Sept. 6, 1902) records seven cases treated under cocaine anæsthesia. Three of his patients recovered. The handling of the intestines and the retraction of the wound are painful, and the mental distress produces shock, however (Woolsey, *loc. cit.*). Goodall found eucaine to be unsatisfactory in the only case in which he tried it.
[4] Le Conte, *Phil. Med. Journ.*, December 13, 1902.

PERFORATION OF A DIVERTICULUM OF THE COLON

Dr. Bristowe, in the "Transactions of the Pathological Society for 1854," drew attention to false diverticula of the intestine. For some years cases of localised chronic or subacute inflammation of the colon have been published, especially in America; but to Dr. Maxwell Telling[1] belongs the credit of drawing attention to the chief cause, the comparative frequency and various consequences of this condition.

The usual cause is inflammation of diverticula which are probably due to chronic constipation. Inflammation of these may lead to thickening of the bowel and its mesentery with incomplete obstruction. In other cases a diverticulum may perforate, especially when a fæcolith has formed within it, and this may set up either localised or spreading peritonitis.

Since surgeons and pathologists have become aware of the condition, a great many more cases have been recognised and reported. It may affect any part of the colon, the rectum, and even the small intestine is not exempt, and diverticula of the appendix are not uncommon. I published two cases of chronic obstruction due to this cause.[2] The specimen successfully removed from one of these is in the museum at Guy's Hospital and shows very well the presence of diverticula along the mesenteric border with perforation into the mesentery which is occupied by a mass of inflamed tissue with necrotic areas and small abscesses. These may burst into the peritoneum and cause peritonitis.[3] As the formation of diverticula in the colon seems to be chiefly due to long-continued constipation associated with failure of the muscularity of the intestinal wall, it is a condition which is not often seen before middle age, and Telling points out that "the average age of those in which the diverticula caused clinical symptoms was fifty-five years" (forty-seven cases). It is, of course, admitted that the presence of diverticula is not the only cause of inflammatory stenosis of the large intestine. Tuberculous infiltration, especially of the cæcum and ascending colon, may closely simulate malignant disease. Gonorrhœal, septic, and tuberculous tubular stenosis of the rectum are well-known conditions. The spread of inflammation from the female pelvic organs may give rise to true stenosis of the sigmoid or pelvic colon. It is very important to remember that a great many cases of local inflammation of the colon, with or without obstruction, have in the past been considered to be due to malignant disease. It is therefore of vital importance to make microscopical examinations of supposed growths of the colon and also to examine all specimens removed very carefully for diverticula. It is not at all easy to find these even when the bowel is laid open. Often they can be found only by the careful use of a probe. It is probable that the patients who survive more than two or three years after a colostomy for supposed growth of the pelvic colon are not really suffering from cancer, but from simple stenosis due to inflammation extending from diverticula.

But obstruction is not the commonest result of these diverticula; attacks of inflammation closely simulating appendicitis are far more frequent. In these the pain and tenderness are on the left side, in the

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[1] *Lancet*, March 1908, vol. i, pp. 843, 928.   [2] *Lancet.*, vol. i, p. 1194.
[3] Mr. Gordon Taylor recorded three interesting cases of peritonitis originating in pouches of the large intestine—one of these was in the ascending colon; *Lancet*, 1910, vol. i, p. 495.

left iliac fossa or in the pelvis. All degrees of inflammation occur. Sometimes perforation takes place with the formation of a localised abscess, which may discharge into the rectum, vagina, or bladder, sometimes with the formation of a temporary or permanent fistula—especially an intestino-vesical fistula. I have operated on one case of this kind. In others the abscess, or the original perforation, opens into the peritoneum and sets up a spreading peritonitis. It is important to remember this disease as a cause of obscure peritonitis.

Apart from obstruction of the bowel the condition is to be treated in the same way as appendicitis and its complications. An inflamed or perforated diverticulum is removed and its stump invaginated. In some abscesses it is difficult to find the perforation, and the surgeon has to be content to drain.

When there is obstruction, with many diverticula and infiltration of the bowel and its mesentery, colostomy with secondary resection of the diseased part may have to be performed. It is impossible to be sure that the disease is non-malignant and in seven out of twenty-seven cases Mayo [1] found cancer grafted on diverticulitis. I have operated on three cases of late peritonitis due to this cause, with two deaths.

As the condition is not often recognised I give full accounts of two of my cases.

PERFORATED DIVERTICULUM OF PELVIC COLON. GENERAL PERITONITIS

CASE 1. Mrs. B., aged 62. Publican's wife. Stout and alcoholic. She had a congested face from mitral disease. For many years she has been suffering from constipation, sometimes going as long as ten days without having the bowels open. For the last year this had been getting worse, and the patient had been having difficulty with her bowels, and she had one bad attack of pain about three months ago, which was associated with much tenesmus and watery motions. She also passed a good deal of mucus and a few streaks of blood. She called her doctor to see her then and she gradually improved, but she had never been quite well since, and the bowels had rarely acted naturally. She often had a great deal of straining, and passed mucus and a great deal of flatus, but no formed motion. She had suffered a great deal of pain at times. On February 17, 1911, she was not feeling very well, and went to bed early and took a large dose of castor oil. About 3 A.M. on the morning of the 18th she woke up in great pain and told her husband that she thought she was bursting, and her doctor was called to see her. He found her very ill. The abdomen was distended. She was in great pain, which was of a colicky nature. Efforts were made to get the bowels open. Three enemata were given and a soft rectal tube was gently passed without effect. The doctor thought he could feel a lump in Douglas' pouch, and he made a diagnosis of intestinal obstruction probably due to a growth in the sigmoid colon. When I saw her at 7 P.M. on the 18th she was groaning with pain. The abdomen was greatly distended. Her pulse was 120 and weak. The abdomen hardly moved, and it was very tender in the lower part, and especially on the left side just above the pubes. The patient said that her pain was in micturition, for which a catheter had been passed, drawing away natural urine. She had been sick a good deal. A diagnosis of peritonitis was made, with a suggestion that it might be due to sigmoiditis arising in diverticula. Immediate operation was advised and performed.

Operation. When the patient was under A.C.E., a swelling was felt in the left iliac region. An incision was therefore made through the left rectus muscle. There was foul fluid free in the general peritoneum. A large collection of fæcal pus was found in the pelvis and mopped away. A search was made for a growth, but none could be found. Some fibroids in the uterus were at first thought to be growth. There was a thick mass in the hollow of the sacrum, and this was found to be inflamed pelvic colon. Its wall was thickened. No definite swelling like a growth could be found, and on bringing the loop towards the wound a perforation was

[1] *Collected Papers, Mayo Clinic,* 1912, p. 200.

found at the root of one of the appendices epiploicæ. The perforation had occurred on the neck of a diverticulum which had projected into the appendix epiploica. The mesentery was thick, and the appendices epiploicæ were very numerous and large, and it was thought that several of them contained saculi. There was peritonitis extending upwards towards the right flank. The cæcum was normal. The tubes were normal. The perforation was sutured, and the appendices epiploicæ were sewn over it. A large tube containing a wick of gauze was placed at the lower angle of the wound and extended into the pelvis, and two wicks of gauze were passed, one upwards and to the right, and the other upwards and to the left. The patient was infused two and a half pints into the axillæ directly she was returned to bed, the operation lasting about half an hour. She vomited a fair amount during the next day, and was weak. The bowels acted on the third day, but the patient died on the fourth day.

PERFORATION OF COLIC DIVERTICULUM. LOCAL PERITONITIS IN LEFT FLANK. SECONDARY SPREADING PERITONITIS

CASE 2. Mrs. S., aged 51. The patient was an abstemious, rather stout woman, who had not yet reached the menopause. She has had very little trouble with the bowels, but she often took a little liquorice powder. There had been no blood or slime. She had been very well until about six months ago, when she had a sudden attack of abdominal pain associated with vomiting. The symptoms passed off after a rest in bed for twenty-four hours, and the patient was able to go out to dinner within forty-eight hours of the onset of the attack. The attack was similar to the present one, but not so severe, and she was not discoloured. The period came on on February 12, 1911. On the evening of the 13th the patient took two lime-juices. At 3 A.M. on the 14th she woke up with pain which gradually got worse. The attack persisted throughout the 14th, and that evening she took some castor oil, which acted well on the 15th. Her temperature was 101° on the 14th. The pain came on in the epigastrium, and towards the evening of the 14th it had settled down in the left flank. It was of a colicky nature and very severe. The patient was very sick on the 14th, but she had not been sick since. She had been kept on a low diet, taking only liquids. The bowels were last opened on the 16th, after a dose of castor oil and an enema. The result was poor. She had not had any enema or opening medicine since. On the afternoon of the 16th she was a good deal better, but in the evening her temperature went up to 103°, and her pulse, which had previously been about 88, was over 100. Towards the evening she had a great deal of pain, and had morphia (gr. 1/6). She then slept until about 3 A.M. on the 17th. The doctor was called to see her. She was in great pain, and he gave her morphia (gr. 1/12). Since then she had had no more morphia. The pulse got quicker and was about 120 when a consulting physician saw her in the afternoon of the 17th. Meanwhile, the patient had become (?) jaundiced. No abnormality could be discovered on rectal or pelvic examination. The period was continuing naturally. The urine was normal. There were no urinary symptoms. There was distinct tenderness and rigidity in the left flank, and the abdomen was more distended than on the 16th. The temperature was 101°. Pancreatitis was suggested, possibly due to the presence of a stone in the common bile duct, with suppuration about the lesser sac of the peritoneum, and operation was advised. I saw her at 9.30 P.M. on the 17th. She was then rather pinched about the face, her cheeks were a little flushed, the tongue was covered with a white fur, and there was a peculiar odour about the breath. The patient complained of colicky pain. The abdomen was considerably distended and mottled red from the application of heat. It did not move much unless the patient was asked to take a deep breath. There was not much rigidity, and this was most marked in the left flank just below the ribs, where also the tenderness was most marked, but there was very little tenderness in the left loin, and no fulness. The pulse was then 110, weak, and intermitting occasionally. The temperature was 100·4°. Pigmentation could not be seen with the artificial light, and it was said not to have been very marked, and was, therefore, disregarded, especially as there was no tenderness in the neighbourhood of the epigastrium or gall-bladder. There was some dulness in the left flank, but none in the right. I suggested a diagnosis of peritonitis in the left flank with gradual spreading forwards. The most likely cause seemed to be some disease of the colon, probably the bursting of a pathological diverticulum. The absence of a history of previous constipation or diarrhœa with blood or slime seemed to exclude

a growth or sigmoiditis. The absence of a previous history of indigestion put out ruptured gastric ulcer to the left of the spine. The jaundice, if any, was not marked, nor early enough for a stone impacted in the common bile duct, but it was thought possible that there might be a stone in the pancreatic duct which had only recently given rise to incomplete obstruction of the common bile duct. Rupture of a diverticulum of the colon, with localised peritonitis now becoming general, was the diagnosis made, especially as there were no fatty or offensive stools and no glycosuria.

Operation (on February 17, 1911). Morphia (gr. ¼) was given, followed by ether and then the abdomen was opened through the left linea semilunaris in its upper two-thirds. Free fluid at once escaped, and lymph was seen upon distended coils of small intestine. The fluid was slightly turbid serum. A gauze roll was used as a pack while the left loin was explored, and then a gush of sero-pus escaped from the flank just below the spleen. When this was mopped away thick pus was seen coming upwards from a perforation in the front wall of an abscess which filled the hollow between the descending colon and the parietal peritoneum and extended downwards nearly as far as the pelvic brim. This pus was mopped away, and the colon palpated. There was thickening at the lower end of the front wall of the abscess, but no definite sacculus could be discovered, and no sufficient thickening for a growth. Therefore, the exploration seemed to confirm the diagnosis. A stab wound was made into the loin, and a tube containing a wick of gauze was inserted. Two wicks of gauze were also passed, one upwards and to the right towards the pancreas which was covered with thick lymph. There was also a good deal of lymph on the mesentery of the upper coils of small intestine. A hand was passed into the pelvis, and foul serum was found there, but no collection of pus. The cæcum, transverse colon, and the stomach seemed to be normal, and the region of the gall-bladder also. The upper part of the wound was sewn with salmon-gut sutures, and the patient was infused two and a half pints into the axillæ. On the 18th she was a good deal better, having slept all the night. Her temperature was normal, and pulse 108. She had a fairly comfortable day. The temperature was 100° in the evening, and pulse 110. She slept five and a half hours on the night of the 18th. On the 19th she was a good deal better, but she was sick, bringing up a large quantity of rather offensive vomit in the morning. She took milk and water and tea, and a little Benger's food. In the evening the temperature was 99·4°, and pulse was 90. The bowels were opened once very freely, the motion being dark, probably from the bismuth which had been taken in the early part of her illness. She was much relieved, and slept well on the 19th. She made excellent progress, the tube being removed on the 23rd. A pelvic abscess had to be opened ten days later. The sigmoid and its appendices epiploicæ were found to be inflamed. Several of the appendices were very much enlarged and hard, and were thought to contain diverticula. The patient made a good recovery, and has remained free from further intestinal symptoms for four years.

Perforation due to other causes. Gunshot and other injuries have been discussed and duodenal ulcer has been treated with gastric ulcer. Perforation may follow simple tuberculous or malignant ulceration or obstruction. It is to be treated along the lines already laid down. When there is irremovable obstruction, the bowel must be drained by temporary colostomy, enterostomy, or whenever possible by lateral anastomosis or unilateral exclusion. With malignant stricture of the colon perforation is very apt to take place in the cæcum, which is the most distended and thinnest part. Here the wide extravasation of fæces and the marasmic state of the patient does not encourage much hope, but a Paul's tube may be inserted at the perforation and the abdomen drained. If the patient survives either a radical or a short-circuiting operation may be undertaken later on.

CHAPTER XXIV

SPLENOTOMY, SPLENECTOMY, SPLENOPEXY

Splenotomy or incision of the spleen has been successfully performed for cysts and abscess. It is the best treatment when there are very extensive adhesions the separation of which might lead to laceration of the spleen with profuse hæmorrhage. Usually the best incision is one parallel to and one inch below the left costal margin, but drainage may be established posteriorly below the last rib or through the thorax after removal of portions of the ninth and tenth ribs, if possible below the pleural reflexion, or failing this, through the lower part of the pleura, which is often adherent, but if it is not the parietal is sutured to the diaphragmatic pleura before the latter is incised. Belloni and Moschini [1] report a successful case treated in this way. An empyema had to be opened later in spite of the precautions taken to avoid infection of the pleura. Rogers [2] records the following interesting and rare case :

Amœbic Abscess of the Spleen Cured by Aspiration and Emetine Injections. A native male, aged 32, admitted with enlargement of the spleen to 2 in. below the left costal margin and a tender prominence of the lower ribs, with redness of the skin over it. On exploration 8 oz. of thick reddish pus and blood, closely resembling that of amœbic liver abscesses, were withdrawn. Three days later there was evidence of refilling of the cavity, so a second aspiration of 4 oz. was performed, and this time 1 grain of emetine hydrobromide in 2 oz. of water was injected. I examined the pus microscopically, and found amœbæ to be present, while it was sterile on culture for bacteria. On each of the next two days half a grain of emetine was injected subcutaneously, but the temperature once more rose, and six days after the second aspiration there was again slight bulging. A third aspiration was now done, but only a little pus and much blood was obtained, and a grain of emetine hydrobromide was again injected into the cavity, and two more ½-grain doses given subcutaneously. The temperature finally fell to normal two days later, and the abscess did not again refill, but complete recovery ensued.

This case is of great interest, both on account of the rarity of amœbic abscess of the spleen and because of its successful treatment by the new method ; for when opened these abscesses heal very slowly and leave obstinate sinuses. It was for this reason that a repetition of the emetine injection into the cavity was carried out, with the fortunate result recorded.

SPLENECTOMY

Indications. (i) *Injury.* This has been already alluded to when gunshot injuries of the abdomen were considered (p. 235). Other cases in which it may be called for are, rupture of the spleen, and stabs of this viscus. A prolapsed spleen, if uninjured, should not be removed but washed clean and replaced. Hitherto surgeons have often been deterred

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[1] *Gax. deg Osped.*, February 1, 1910.
[2] *Brit. Med. Journ.*, 1912, August 24, p. 407.

from attempting to remove a ruptured spleen by the frequency with which this injury is complicated by injury to other abdominal or thoracic organs, especially the liver, from the shock of which some patients never rally sufficiently to justify exploration.   Three successful cases of splenectomy for rupture of the spleen were brought by Messrs. Ballance and Pitts before the Clinical Society.[1]

In the first case, under Mr. Ballance, a boy, aged 10, had been struck five days before his admission into St. Thomas's Hospital by a " full-pitched ball " on the left side.   Severe pain followed but passed off until a few hours before admission. At this time severe shock was present from which the patient rallied slightly.   The spleen was removed through a four-inch incision in the left linea semilunaris.   It was noticed that a spleniculus was left behind.   The boy recovered rapidly, and was in robust health five months later, but the superficial glands had enlarged.

In the second case, also under Mr. Ballance, the patient, a woman, aged 45, had been run over by a hansom cab.   Shock was so marked a feature that operation was not justified until the next day.   Though the patient left the theatre in a desperate condition, in ten days she was apparently convalescent.   Then she began to go downhill, and by the eighteenth day her condition was again critical, with weakness, emaciation, thirst, drowsiness, &c.   The administration of extract of sheep's spleen and raw bone marrow daily restored her gradually to convalescence and ultimately to complete recovery.   Some groups of external lymphatic glands could be felt in this case.

In each of these cases the spleen was not only ruptured, in the third completely across, but the vessels in the hilum were torn across also.   The authors remarked that where this was not present a rupture of moderate severity might perhaps be treated by suture, but the objection to this is that the laceration is often difficult of access, and especially that the spleen is very friable.   If the attempt is made the pedicle must be clamped first to prevent the furious bleeding which may otherwise make suture more dangerous than excision.   As to the diagnosis of ruptured spleen these brilliant successes point to the value of the following : (a) The locality of the injury ; (b) the evidence of internal hæmorrhage ; (c) abdominal rigidity and marked increase of fixed splenic dulness ; (d) the evidence of an increasing collection of fluid in the abdomen, and of the fact that while the dulness in the right flank can be made to disappear by change of position, that in the left flank remains constant.   The operation should be performed as soon as the diagnosis is made, for to wait for reaction from shock and collapse is to wait for more hæmorrhage, and to throw away the fair chance the patient may have of recovery from early operation.   When the bleeding is not severe enough to cause death within a few days, the blood clot may become infected from the bowel, causing localised or diffuse peritonitis.   The peritoneal sac should be rapidly cleansed from all blood and clots.   Every precaution for meeting shock should be taken before, during, and after the operation.

The writer had a boy, aged 17, under his care, who had run against the posterior edge of a hand cart, striking his abdomen and left lower ribs.   After sitting down in pain for fifteen minutes he was able to walk about a mile, and five hours later he came to Guy's Hospital.   He walked to and from the tramcar.   He was rather pale on admission, with a rising pulse of 110–120.   His abdomen was quite rigid and very tender.   It was also becoming fuller and its resonance was impaired in the left flank and left iliac region.   As the diagnosis was uncertain between laceration of the jejunum and its mesentery, and ruptured spleen, a vertical incision was made through the left rectus.   A large amount of clot and blood at once escaped, and a rupture of the spleen was felt.   The relief of intra-abdominal tension seemed to increase the bleeding, which was furious, until the pedicle was secured with a strong

clamp. Although the wound was long it was impossible to get proper access to the spleen, which was high and adherent, until another incision was carried downwards and outwards from the upper end of the vertical one. The rent was a large antero-posterior one almost dividing the organ and extending into the hilum, so that suture was hopeless. Moreover the spleen was very friable. It was difficult to get at the pedicle until it was divided close to the spleen and well away from the clamp which held the tail of the pancreas as well as the vessels. The pedicle was transfixed in front of the clamp and tied with a Staffordshire knot of strong catgut. Meanwhile the patient was being infused into the axillæ. Five pints were given during and soon after the operation. There was much blood in the abdomen, especially in the pelvis, which was rapidly cleaned out. The patient made a good recovery and was able to leave the Hospital in three weeks.

Prognosis. Without operation perforation or laceration of the spleen is almost certain to end fatally. With early operation, usually splenectomy, about 70 per cent. may be expected to recover.

(ii) *Suppuration in or involving the spleen* is a rare indication. As a rule incision and drainage are better and safer than splenectomy. Usually splenic suppuration is due to an infected embolus, thrombosis or hæmatoma. Generally a source of infection such as appendicitis is to be found in the abdomen.

(iii) *Tuberculous Spleen.* A few successful splenectomies for this condition are recorded, but it is rare to find tuberculosis limited to the spleen.

(iv) *Cysts of the Spleen.* These may be simple, serous, sanguineous or hydatid. As a rule non-parasitic cysts are best incised and drained. Hydatid cysts, if limited to the spleen and not very adherent, are best treated by splenectomy. Usually the disease is not limited to the spleen.

(v) *Movable or Wandering Spleen.* When this condition causes troubles, analogous to those of movable kidney, not relieved by a belt or splenopexy.

Dr. McGraw[1] removed an enlarged and dislocated spleen, which formed a tumour in the right iliac fossa, and partially displaced the uterus and bladder. A week later pain in the left shoulder and left-sided pleuro-pneumonia supervened. Nine months afterwards the ligature was coughed up. Recovery followed.

The prolapsed spleen is often enlarged, and its pedicle may get twisted. Twisting of the pedicle and dislocation may lead to symptoms of chronic or acute intestinal obstruction, from interference with the colon. I have operated upon one case in which a diagnosis of intussusception had been made, the twisted and prolapsed organ having been mistaken for the tumour of that disease. The spleen was untwisted and replaced, and the child recovered. No sutures were used to fix the spleen, on account of its congested state, and the grave condition of the infant.

Operation is far more satisfactory here than in most other morbid conditions of the spleen, as shown by the statistics which are given by Collins Warren.[2] During the previous ten years, forty-three cases of extirpation of wandering spleen were recorded with only three deaths.

(vi) *Malignant Disease.* Primary sarcomatous disease of the spleen is extremely rare. Up to the year 1890, five cases of splenectomy for sarcoma were reported by Hagen, of which three recovered and two died. From 1891–1900 Warren reports five further cases, including one of his

[1] *Med. Rec.*, vol. xxxiii, No. 26.
[2] *Ann. of Surg.*, 1901, vol. i, p. 521.

own, of which four recovered and one died. Jepson and Albert [1] have collected thirty-two cases, with eleven splenectomies and one enucleation. Three of the eleven patients died from the operation, and three of recurrence. Two have survived for more than four years.

(vii) *Splenic Anæmia and Splenomegaly* (Banti's disease). This condition must be carefully distinguished from splenic leukæmia. The latter is associated with marked leucocytosis, which is not the case in splenic anæmia. The chief symptoms are splenic hypertrophy, gradually increasing anæmia, of the secondary-type (leucopænia), and a tendency to hæmorrhages. Collins Warren describes a case in which the disease was cured after removal of the spleen, and also mentions seven cases reported by Sippy, five of which recovered after splenectomy. Levison [2] records a successful case, and refers to another by Harris; also to sixteen recorded by Maragliano and Terille with three deaths, two from hæmorrhage, but the diagnosis was not certain in either of these. Abortion followed the operation in one case and curetting proved fatal. Splenectomy is very hopeful in the early stages of Banti's disease before cirrhosis of the liver, ascites and extreme anæmia are allowed to develop. The same is true of some other forms of splenic enlargement of uncertain cause without anæmia. Possibly some of these in children are syphilitic although they do not react to salvarsan. Mayo records ten splenectomies with only one death. [3] Egyptian splenomegaly, a common disease of unknown cause incurable by medical treatment, is curable by splenectomy before the onset of severe cirrhosis of the liver with jaundice and ascites. Owen Richards and H. B. Day [4] discuss this in an able paper, and record eleven splenectomies with three deaths.

(viii) *Malarial Spleen.* With regard to the question of operation for this condition Collins Warren says : " Quite a number of malarial spleens have been removed in recent years, and the mortality per cent. of the operation is still diminishing. Hagen has collected 88 cases of malarial hypertrophy of the spleen, exclusive of wandering spleen. Of these cases, 24 previous to the year 1890 gave a mortality of 62·5 per cent., while 64 cases operated on after the year 1890 gave a mortality of 23·4 per cent. When we consider the very large size that the organ often attains in this disease, and the unfavourable constitutional condition of the patient, such results, if not all that we could hope for, are at least encouraging." Such a spleen may be removed when its size and mobility give rise to trouble in spite of medical treatment. A malarial spleen is also very liable to rupture from injury.

It is of no use removing the spleen for leukæmia.

Operation. The preliminary steps will be directed to ensure asepsis and to diminish shock. A vertical incision through the upper part of the left rectus is generally made in traumatic cases so that the whole abdomen can be properly explored. For other cases, a wound parallel to and one inch below the left costal margin and across the left rectus gives better command over the pedicle. In any case the incision must be made free enough to give easy access to the pedicle without the need of traction upon the latter. Additional room may be gained by division of the left rectus, retracting the left costal margin or removing the eighth, ninth and tenth

[1] *Ann. of Surg.*, 1904, vol. xl, p. 80.
[2] *Ibid.*, vol. xxxviii, p. 670.
[3] *Journ. Amer. Med. Assoc.*, January 1, 1910.
[4] *Trans. Soc. Trop. Med. and Hygiene*, July 1912.

costal cartilages below the pleural reflexion. The peritoneum is opened freely and the hand explores the tumour. If at this stage the surgeon is satisfied that the adhesions between the spleen and the diaphragm are extensive and intimate he will do well to close his wound. If, however, it is decided to proceed, any adhesions, as of the overlying omentum, are separated, between ligatures if needful. Where the adhesions are very
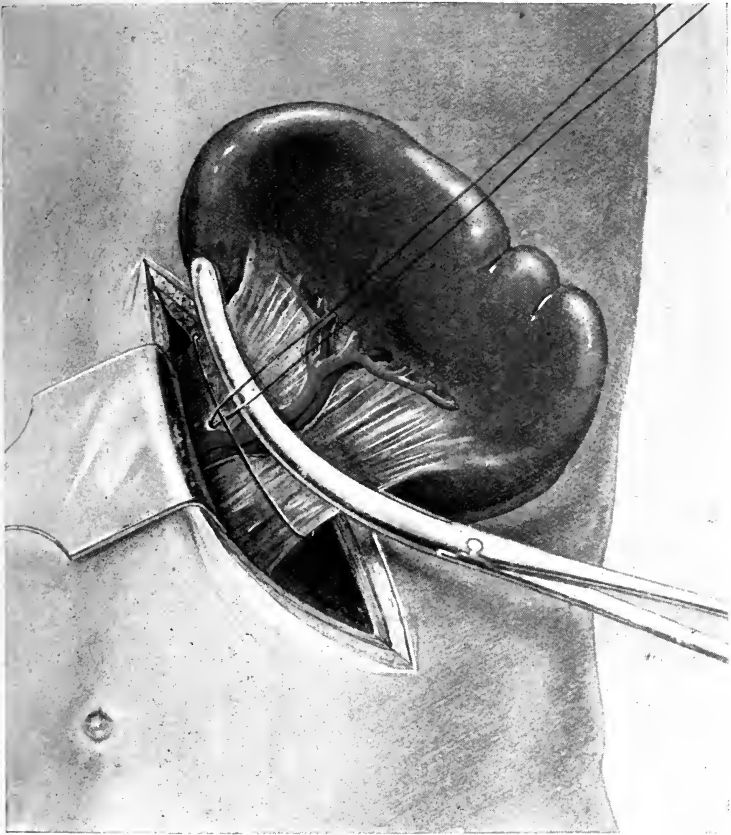
FIG. 213. Splenectomy. The pedicle is clamped, and a Staffordshire knot is placed ready for tying.

broad, interlocking chain-ligatures must be employed. Any adhesions to the pancreas are very difficult to deal with. Esmarch and Kowalzig advise removal of a portion of this viscus. The hand is passed above the spleen and the latter is brought downwards, inwards and forwards into the wound, and sterile gauze is carefully packed around it. This extraction of the viscus must be carried on with the utmost caution and gentleness, as its friability may easily lead to a tear and most profuse oozing, and as dragging on the pedicle may easily induce collapse, and is also likely to lead to some small vessel retracting from the ligatures as they are applied, and causing fatal hæmorrhage.

The spleen being wholly outside the body, the most important part of the operation, securing the pedicle, remains. The lieno-renal ligament

and the gastro-splenic omentum have to be tied. Collins Warren finds that the remainder of the operation is greatly facilitated if the spleen is at this stage rotated forwards so that the posterior surface of the organ is in front. A better view of the pedicle is thus obtained without stretching, and the application of ligatures is therefore rendered easier. The pedicle, if present,[1] must now be carefully examined. If the patient's condition is good, the safest plan will be to secure the vessels as far as possible separately, the pedicle being divided as the late Mr. Greig Smith suggested, piecemeal between pressure-forceps ; where there is not time for this, it will be wiser to secure the vessels in two or three portions, transfixing in two places, and interlocking the ligatures. Long clamp-forceps are very useful to secure and hold the whole pedicle (see Fig. 213). They are especially valuable to arrest the furious bleeding from a ruptured spleen. The wide pedicle is then transfixed and ligatured between the clamp and the stomach. Strong catgut or linen thread should be used. However the pedicle is treated care should be taken : (i) To prevent any tension being exerted on the pedicle (vide supra). (2) To secure every vessel. (3) To divide these, in a relaxed condition, at a sufficient distance from the ligatures. (4) After all the ligatures have been applied it is well for the sake of safety to throw one round the whole. (5) Not to twist the spleen round at all in dealing with the pedicle.[2] When oozing from adhesions is very likely to take place, especially when a large gap is left by the removal of a huge spleen, plugging with gauze after the method of Mikulicz will be advisable.

The abdominal sac is next cleansed and the parietal wound completely closed except in septic cases or those requiring temporary gauze packing for troublesome oozing.

Causes of Death.   By far the most frequent is hæmorrhage. This may be from the omentum adherent over the spleen, from the large vessels to this viscus, from some small vessel which has retracted, from the splenic vein, or from sponge-like adhesions.   In these cases of sudden loss of great amount of blood, axillary infusions may not be absorbed with sufficient rapidity, therefore intravenous saline infusion of about three pints is strongly indicated.

Mr. Hatch, of Bombay,[3] met with a case in which death took place a few hours after the splenectomy, owing to oozing from some adhesions between the spleen and the diaphragm, which had required separation.[4] The pedicle was safely secured. In another case,[5] death, twenty-four hours after the operation, was due to bleeding from the abdominal incision, owing to defective coagulation of leukæmic blood. The ligature on the pedicle was firm.

SPLENOPEXY OR FIXATION OF A WANDERING SPLEEN

This is an operation which is rarely required, for undue mobility of the spleen is usually only a part of Glenard's disease, when it can be best treated by means of abdominal supports. In other cases the mobility is due to an increase of size, due to organic disease, which may or may not

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[1] In a case of Mr. L. Browne's (Lancet, vol. ii, 1877, p. 310) there was no pedicle as such, four very large arteries being met with and secured with double ligatures.
[2] Sir S. Wells (Med. Times and Gaz., January 6, 1866, p. 4) draws attention to this. Having done so in order to bring the vessels into a cord, the splenic vein was ruptured.
[3] Lancet, 1889, vol. ii, p. 1053.
[4] See also G. A. Wright's case (Med. Chron., December 1888). This surgeon suggests the use of a long, sharply-curved tenaculum for stopping bleeding from a deeply-seated vessel in the back of the abdomen.
[5] Centr. f. Chir., July 18, 1885.

require operative treatment. In some cases, however, a wandering spleen may cause pain, sickness, and faintness, and may prevent the patient from leading an active life. When a good belt has been well tried and has failed to afford relief, an operation may be suggested.

In suitable cases without any disease of the spleen, but only undue mobility, splenopexy should be preferred to splenectomy, and it ought to be more free of immediate danger and of possible changes in nutrition (p. 442).

Operation has only been adopted in a few cases so far, and in these a different method has been invented for almost every patient.

Mr. J. Basil Hall has contributed an interesting article upon the subject,[1] and he has recorded a case of his own in which he used an ingenious method. He collected nine cases, including his own, with no deaths, but since then a few more operations have been performed. The following are some of the methods that have been employed.

In 1895 Kouwer (quoted by Basil Hall) used a lumbar incision and induced the formation of adhesions by means of tampons placed around it. This proved successful in one case, the spleen being well fixed four years later. The tampons had to be removed from another patient, because they produced symptoms of intestinal obstruction.

Rydygier, in 1895, made a pouch for the spleen, between the parietal peritoneum and the diaphragm upon the lateral wall of the splenic fossa ; this he performed through a median abdominal incision.

Tuffier, Giordano, and Greiffenhagen have passed sutures through the parenchyma of the spleen and the parietes ; severe hæmorrhage followed in Greiffenhagen's case. The spleen is so friable that all suture methods are to be condemned.

Bardenhauer made a vertical incision in the left flank, and separated the peritoneum from the parietes. He then brought the spleen out through a small opening in the peritoneum. This opening was narrowed round the pedicle, so that the spleen was retained in the subperitoneal tissues, and the wound closed over it.

Basil Hall fixed only the lower part of the viscus in the wound by narrowing the peritoneal incision and posterior rectus sheath, so that the edges gripped the spleen, at the narrow isthmus formed by a deep notch upon the anterior border near the lower pole. He also promoted the formation of adhesions by rubbing the peritoneum of the splenic fossa. The rectus muscle was brought over the prolapsed part, and the wound closed. The patient was completely relieved.

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[1] *Ann. of Surg.*, vol. xxxvii, p. 481.

CHAPTER XXV

OPERATIONS ON THE LIVER

INJURIES, HYDATIDS, HEPATIC ABSCESS, REMOVAL OF GROWTHS OF THE LIVER

OPERATIONS FOR INJURIES

THE liver is subject to two chief kinds of injuries, (*a*) perforating wounds such as stabs and gunshot wounds and (*b*) subcutaneous laceration from crushing injuries. As a rule injuries of the liver are very serious on account of (*a*) the rapid and severe hæmorrhage associated with them and (*b*) the other injuries so frequently complicating them.

Indications for Operation. When, after an injury in this neighbourhood, signs of internal hæmorrhage with collapse, abdominal rigidity and dulness in the right flank appear, an operation should be undertaken without delay. As a rule it is better to open the abdomen in front so that a thorough exploration can be carried out. One of the incisions commonly made for exposing the gall-bladder serves well. In some cases, however, there may be some difficulty in reaching wounds upon the posterior and right surface of the liver, and in these cases it may be necessary to make an incision through the thorax either behind or at the side, if possible below the pleura by removing portions of the lower ribs or rib cartilages, and, failing this, through the pleura after sewing the parietal and diaphragmatic surfaces together before incising them. Often the need of this posterior incision can be avoided by dividing the suspensory (the coronary or right lateral) ligaments, and thus mobilising the liver as far as possible. Towards the end of the operation the ligaments can be sewn up again. Directly the abdomen is opened the liver is examined, and a laceration having been found, hæmorrhage is checked by placing a soft-bladed intestinal clamp on the lesser omentum at the foramen of Winslow and thus securing the portal vein and hepatic artery while the laceration in the liver is rapidly closed by suture. Stout catgut is the best material to use, for thin sutures cut through the friable liver and thin-walled blood-vessels. The stitches should be interrupted, about one-third of an inch apart and passed so that they entirely surround the wound. When the latter is near the free border the suture should pierce the whole thickness of the liver about one-third of an inch away from the edge of the laceration. The stitches are tied slowly but firmly. Occasionally a large vessel may be seen upon the cut surface and this may be held with forceps and tied separately. Some wounds, which from their position and extent do not lend themselves to suture, should be packed with gauze, but a few sutures should be passed if possible to keep the flaps together. When the sewing

has been completed the clamp upon the vessels is removed, and if any hæmorrhage occurs some more stitches should be inserted to control it. The clamp is very useful in controlling hæmorrhage and in enabling the surgeon to do quicker and more effective work ; but it must not be left on a moment longer than is necessary on account of the congestion of the intestines, which obstruction of the portal veins produces.   J. H. Pringle [1] found that total occlusion of the portal vein for one hour did no harm. McDill [2] introduces an intestinal clamp through a puncture in the abdominal wall below the right costal margin in the axillary line.   The blades are guided into position with the left hand in the anterior wound.   It is safe to leave the clamp on the vessels for at least ten minutes at a time. The vessels may be controlled by the fingers and thumb of an assistant. When the bleeding has been completely stopped the abdomen may be completely closed, but when some oozing continues or a gauze pack has been used, the upper part of the wound is left open for drainage for a few days.   It is not wise to remove the gauze for at least five days, otherwise bleeding may recur.

OPERATIONS FOR HYDATIDS

Incision and enucleation will be described ; the milder measures of puncture and electrolysis proved successful in many cases, but we do not know for certain how the death of the parasite was brought about by them in successful cases.   At the present time these uncertain methods have been rightly abandoned, although they were useful in pre-antiseptic days, when they were much safer than the more radical procedures.   The surroundings of hydatids of the liver are of truly vital importance, and sudden death has followed tapping more than once.   Thus, in Mr. Bryant's case,[3] while a hydatid cyst was being tapped, the portal vein, which had been pushed upwards and forwards by the projection of the cyst on the under-surface of the liver, was transfixed.   Death followed in five minutes, and was thought by Dr. Fagge to be due to hydatid fluid being sucked into the vein as the trocar was withdrawn.

In a Russian case [4] the pulse suddenly stopped while the cyst, which had been exposed by abdominal section, was being stitched to the incision At the necropsy, a crumpled echinococcus had made its way into the right auricle, and a fragment of one into the right division of the pulmonary artery, by an opening between the thinned cyst and the inferior vena cava.   Mr. Willett [5] mentioned a case in which he had to aspirate a doubtful swelling of the liver.   He used an ordinary-sized needle, and within two minutes the patient was dead.   It turned out to be a case of malignant disease.   No large vein had been pricked, and there was no hæmorrhage.   The sudden, fatal syncope seemed due to the impression made on the nervous system through the solar plexus.   Several other deaths from syncope have been recorded.   Peritonitis, empyema, or sub-diaphragmatic abscess may arise from leakage at the point of puncture after the withdrawal of the needle or trocar.   Hydatid infection of these regions may also occur from the same cause.   Suppuration in the sac occasionally took place even after taking all precautions against infection from the instruments employed.

[1] *Ann. of Surg.*, October 1908.
[2] *Journ. Amer. Med. Assoc.*, 1912, vol. ii, p. 1283.
[3] *Clin. Soc. Trans.*, vol. xi, p. 230.
[4] *Lond. Med. Record*, 1885, p. 414.
[5] *Brit. Med. Journ.*, November 13, 1886.

(a) **Incision and Drainage.** *Indications.* This method is to be preferred to enucleation when suppuration has occurred within or around the sac, when the latter is calcareous and adherent to vital structures, when severe hæmorrhage occurs, when it is important to complete the operation without delay on account of pulmonary complications, and when it is impossible to remove the disease completely. It may be carried out in one or two stages, but it is better to complete the operation at one sitting if possible.

Operation in one Stage. The incision should, if possible, be made in front. Sufficient access may be usually obtained through one of the incisions used for exploration of the gall-bladder (*see* Fig. 216, p. 469). Even if a cyst or abscess shows its greatest point of prominence through the ribs, it should not be opened here unless it is quite certain that the pleural space is obliterated; moreover, the large drainage-tube needful necessitates resection of a portion of a rib. In rare cases the thoracic route is the best, when the hydatid is placed upon or near the convex upper surface of the liver. Even in these cases the liver may be reached below the reflection of the pleura, which may be displaced upwards (*see* Fig. 79, p. 140). The abdomen having been opened and rapidly explored with the hand passed in all directions, especially along the upper surface of the liver and into the pelvis, a sterile gauze pack is placed below the liver, and the edges of the wound are protected with enveloping pads. This is an important step which is necessary to prevent grafting of hydatid. Quenu injects the cyst with 300 grammes of a 1 per cent. solution of Formol directly it is exposed, with the object of sterilising the contents before they are liberated.

The needle of an aspirator or a fine trocar is then thrust into the front of the swelling in the liver, and the existence of fluid beneath thus verified, and the fluid evacuated as far as possible. As the needle is withdrawn the liver is incised, and a finger quickly plugs, and then enlarges to an inch and a half, the opening made by the knife. Hæmorrhage, if free, is arrested by pressure and suture. Escape of fluids into the peritoneal sac is prevented by the use of the tampons already mentioned, by an assistant keeping the edges of the wound carefully adjusted to the liver, and, lastly, by the next step, which consists in hooking up the opening in the liver with the finger, and in stitching the edges of the wound in the liver to that in the abdomen with a continuous suture of catgut. While inserting this, care must be taken to unite peritoneum to peritoneum, and to take up a sufficiency of liver-tissue by inserting the needle well away from the edges of the wound. As the sutures are inserted the gauze pack, &c., must be gradually withdrawn, and, if the fluid escapes very freely, it may be well to turn the patient over on one side. Any scolices which are within reach are next removed, and, if the cyst is firmly stitched and the patient's condition good, the contents and wall of the hydatid may be cleared out with sponges on holders, aided by scoops. All handling must be of the gentlest. A large drainage-tube is then inserted, and the usual gauze dressings applied.

Operation by Two Stages. The abdomen is opened and explored as described above. To make certain of the position of the fluid, a fine trocar may be now thrust into the prominent part of the liver. If the cyst be crammed with scolices, very little fluid escapes; if it be an acephalocyst, the fluid may spurt out under the high pressure not infrequently met with. After a few ounces have been withdrawn, any

leaking is stopped by sponge pressure or suture, the parietal peritoneum is stitched to the edges of the wound by a few points of catgut suture, the wound plugged with strips of gauze, and the dressings firmly bandaged on with a good deal of pressure so as to keep the abdominal wall as far as possible in contact with the liver.[1] On the third day the operation is completed by incising the liver, now well adherent, and inserting a large drainage-tube. This method is rarely used except when suppuration has taken place in the cyst.

(b) *Enucleation.* This method was first introduced by Mr. Knowsley Thornton [2] and is based on the facts that the endocyst can nearly always be separated from the ectocyst without difficulty or hæmorrhage, and this ensures a radical cure, without risk of hernia. A number of cases treated in this way have been reported, and the success met with has been considerable. Thus Posadas [3] reports twenty-three cases, of which nineteen recovered, and four died.

The tumour is exposed by a free incision, and isolated from the rest of the peritoneal cavity by means of gauze. After being emptied the whole endocyst is enucleated from the ectocyst and the liver ; the cavity in the latter is then obliterated as far as possible by means of continuous catgut sutures, and the hepatic and abdominal incisions are sutured without drainage. This operation is not suitable for suppurating cysts, but in other cases it is very successful although suppuration has occurred in the infolded cysts in some cases, requiring secondary drainage. Pedunculated hydatid cysts originating in the liver have been completely excised. The writer successfully excised a hydatid the size of a fœtal head from the inferior surface of the liver. Hæmorrhage was arrested by careful sewing with catgut.

OPERATIONS FOR HEPATIC ABSCESS

Tropical abscess of the liver is usually amœbic in origin. Rogers [4] found a history of dysentery in 90 per cent. of undoubted liver abscesses. Eighty per cent. are sterile when opened, but later micrococci invade the majority and contribute seriously to the mortality, which has been estimated at 60 per cent. Therefore it is clearly most important to do everything possible to avoid secondary infection during and after operation. In the majority of cases tropical abscess is solitary and is situated in the right lobe in 85 per cent.,[5] mostly at the upper and posterior part. Solitary abscess is sometimes found in patients who have never been abroad, generally due to infection from the intestines, which may be ulcerated. Unfortunately septic or pyæmic abscesses are usually multiple. In suppurative pylephlebitis numberless small abscesses form so that the condition is beyond surgery.

The most important signs are irregular fever, profuse sweating, severe pain and local tenderness over the liver, increased liver dulness with diminished mobility and perhaps enlargement of the right side of the chest, pulmonary complications on the right side, and leucocytosis with increase of the polymorphonuclear cells.

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[1] One case bulged out the right lower ribs most markedly. For reasons already given, I preferred to attack it in the front of the right hypochondrium. On exposing the liver, a hydrocele trocar passed through an inch and a half of hepatic tissue before fluid was reached. Very little hæmorrhage followed the completion of the second stage of the operation. [2] *Med. Times and Gazette*, 1883, vol. i, p. 89.
[3] *Revue de Chirurgie*, March 1899, p. 374.
[4] *Brit. Med. Journ.*, October 24, 1908. [5] R. Havelock Charles, *ibid.*

Rogers [1] has shown that ipecacuanha in large doses, and especially emetine given hypodermically, frequently cures amœbic hepatitis before or even soon after the onset of suppuration. This treatment should always be tried before advising operation. Emetine hydrochloride can be injected subcutaneously in gr. $\frac{1}{2}$ doses twice daily without inducing vomiting. This is a discovery of the greatest importance. I venture to quote Dr. Rogers as follows :

SUGGESTED NEW TREATMENT OF AMŒBIC ABSCESS OF THE LIVER

" **Principle of Treatment of a Protozoal Produced Abscess.** The proof that tropical abscess of the liver is caused originally by a protozoal organism, and is, in the vast majority of cases, free from staphylococci and bacteria, at once suggests that the best method of treating it may differ widely from that universally adopted in the case of ordinary septic collections of pus. This principle has already been widely adopted in the case of large cold tuberculous abscesses, which are not usually drained by the open method, but are commonly emptied by the aspirator and iodoform or other tubercle germ-destroying substance injected into the cavity. On similar lines I have already described [2] the success in certain cases of aspiration and injection of quinine (which kills the causative amœba) for tropical liver abscess, and equally good results have since been obtained in two cases reported to me by other observers. It has been most successful in small deep-seated abscesses containing from half to one pint of pus, but has failed in several larger ones, although without any deleterious effect on the subsequent treatment by the open method. In earlier days repeated aspiration alone was frequently used with success, Lt.-Col. Lawrie [3] in 1892 having reported eighteen cases with fifteen cures, and three deaths from dysentery ; but with the general adoption of aseptic methods the open operation has practically entirely replaced aspiration, without, however, effecting as great a triumph as in most other surgical operations, for the reasons already pointed out. The principle, indicated by our present knowledge of the pathology of the disease, on which its correct treatment should, I think, be based, is to remove the collection of pus, without admitting the germ-laden air to its usually sterile serum-culture-medium-like contents, and at the same time allow of the application of quinine, or other amœba-destroying solutions, to its protozoal-parasite-containing walls, as often as may be necessary to bring the pathological process to an end, and allowing its greatly reduced and still sterile contents to become encysted, as occasionally occurs as a result of Nature's efforts. A single aspiration and injection of quinine, although well worthy of trial in early cases, sometimes fails to completely stop the pathological inflammatory processes ; while it will be some time in such cases before the collection of matter becomes large enough to permit of a second aspiration, so that free drainage is then usually resorted to. To get over this difficulty I have devised the following method of giving repeated quinine irrigations, which I am anxious to bring to the notice of those who may be in a position to give it a trial."

" **The Technique of Aspiration.** The ordinary straight, stiff aspiration cannula cannot be left in the cavity of a liver abscess for the purpose of

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[1] *Brit. Med. Journ.*, June 22, 1912, p. 1424.
[2] *Ibid.*, June 16, 1906.   [3] *Indian Med. Gaz.*, 1892, p. 347.

repeated irrigation. It, however, occurred to me that if it could be made of flexible silver tubing, such as an inner tracheotomy tube, it might safely be left in and used for siphon drainage and irrigation, being connected by a long piece of rubber tubing with a vessel containing some non-toxic antiseptic so that no air can enter the abscess cavity. Last year, when in England, Messrs. Down Brothers kindly carried out this idea for me in a very successful manner. The sheath is so flexible that it can quite safely be left in after withdrawal of the trocar, and will accommodate itself to any altered relationship of the parts traversed, due to shrinkage of the abscess cavity. The space between the tubes in the handle are connected by a piece of thick-walled pressure rubber tubing, which is clamped as the trocar is withdrawn, to prevent any entry of air while it is being connected with the aspirator, or with the antiseptic-containing vessel under the bed for siphon drainage. A piece of silver Y-tubing is also provided to allow of washing out with quinine solutions,
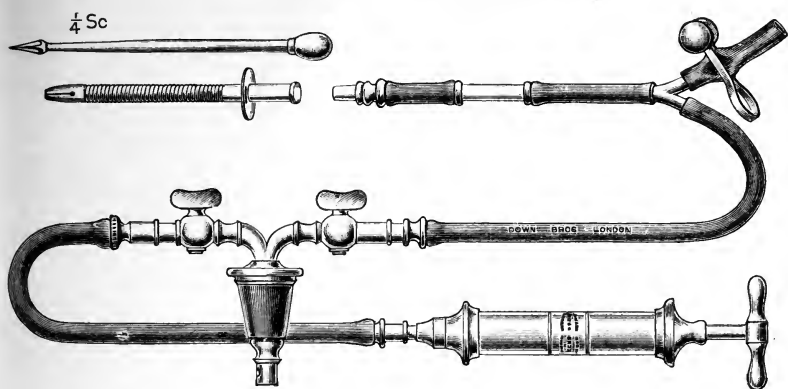
FIG. 214.   Rogers flexible tube for draining hepatic abscess.

the soluble bihydrochloride, in a strength of 3 to 5 grains to the ounce, being used, the weaker strength for large abscesses and the stronger for small ones, so as to limit the total quantity of the drug left in the cavity (see Fig. 214).

"By this means, after aspirating the pus from the cavity, a few ounces of the quinine solution, not containing more than thirty grains of the salt, are injected into the cavity by means of a glass syringe and left there. A dressing is applied over the wound around the tube. If the abscess is a small one siphon drainage may not be necessary, and in any case it can be stopped at night by clamping the exit tube to allow of the patient changing his position, if this is thought to be advisable. On the following day the aspirator is again connected up and any accumulation of pus removed, after which the quinine solution is run in through the other limb of the Y-tube, most simply through a funnel covered with aseptic gauze to prevent dust falling in, care being taken that it is not allowed to completely empty itself, so that no air can enter. Suction may be again applied, and the cavity thus washed out with the sterilised quinine solution, some being always finally left in. Daily irrigations should rapidly lessen the quantity and thickness of the discharge, just as happens in the open method when the wound remains sterile and quinine injections are used, so that in small or medium-sized abscesses, when the discharge or material removed by aspiration is reduced to a little thin serous matter

free from amœbæ and bacteria, the tube may be removed, and the cavity and any sinus in its track should rapidly heal under aseptic dressings. The repeated use of the aspirator to abstract the discharge accumulating in the abscess cavity allows of the thick contents being removed through a considerably smaller cannula than would suffice for ordinary drainage by the open method, while in my experience quinine injections rapidly reduce the consistence of the pus to a remarkable extent.   The fact that a single aspiration and quinine injection not rarely suffice for the complete cure of bacteria-free amœbic abscesses of the liver affords strong grounds for believing that repeated quinine irrigation, without the admission of air, will suffice for the rapid cure of a still larger number of cases, and do away with the necessity of laying them freely open, with all the risks of that method.   Even if it fails to completely cure the case, the cannula remains as a guide to opening the cavity, when the discharge will be much less than if it had been incised straight away, with a corresponding greater chance of preventing subsequent bacterial infection.   This method is only advised for liver abscesses with sterile contents, so at the first aspiration the pus removed should be at once stained and microscoped, and, when possible, cultures made, and if numerous staphylococci are found, incision and drainage should be carried out.

"It will be observed that Sir Patrick Manson's liver abscess trocar is intermediate in position between the open operation and that which I now suggest, but his plan does not provide for the total exclusion of air from the cavity and the repeated irrigation with quinine solutions with the help of the aspirator, which are the essential principles of my method.   My instrument may also prove useful in other conditions, such as tuberculous abscesses and some forms of cysts."

· Rogers [1] records the following interesting cases illustrating his methods of treatment by simple aspiration and emetine injection into the abscess cavity and subcutaneously.

"*Amœbic Abscesses of the Liver and Spleen Cured by Aspiration and Emetine Injections.*   As early as 1902 I showed that unopened amœbic abscesses of the liver are, in the great majority of cases, sterile as regards bacteria, and therefore suggested removing the pus by aspiration, and injecting soluble salts of quinine into the cavity to kill the amœbæ in the wall of the abscess, in the place of the exhausting open operation with prolonged drainage.   Later, I advised in addition the continued administration of full doses of ipecacuanha after any form of operation on such abscesses.   This method is being used with increasing success in Calcutta at the present time, although it fails in some cases.   The proof afforded in my recent paper that soluble salts of emetine rapidly kill the amœba of dysentery when used in much higher dilutions than the quinine salts, clearly indicates the former drug as the more efficient one for the purpose just mentioned. Moreover, the evidence above recorded in this paper, to show that emetine can be given in sufficient doses to kill off rapidly all the amœbæ in the greatly thickened wall of the large bowel in acute dysentery, made it highly probable that it would act equally well on the parasites in the walls of amœbic abscesses of the liver.   The following remarkable case will show that this is actually the case."

CASE 1.   *Acute Amœbic Dysentery with Multiple Liver Abscesses, in which all the Amœbæ in the latter were killed by Subcutaneous Injections of Emetine.*   A native

[1] *Brit. Med. Journ.*, August 24, 1912, p. 405.

male, aged 30, was admitted in a very low state for severe dysentery of two months' duration. I examined the stools and failed to find any amœbæ, but as he was not improving ½-grain doses of emetine were injected twice on two consecutive days, making a total of 2 grains in all. The dysenteric stools decreased in number and much improved in character, but he remained in a low condition, and died twenty-six hours after the last injection. At the *post-mortem* examination I found extensive ulcers of the amœbic type throughout the large bowel, but, with the exception of one extensive sloughing one in the cæcum, their bases were clean and smooth and their edges overhanging, as if they had recently lost the usual tawny yellow gelatinous infiltration. The cause of death was found to be very numerous small recent amœbic abscesses of the liver from ½ in. to 2 in. in diameter, scarcely a square inch of the cut surfaces being free from them. The pus from several of them proved sterile as regards bacteria on culture. I spent a long time examining scrapings from the walls of a number of the abscesses, but failed to find a single living amœba, although in similar cases I had always been able to detect them with the greatest ease. On adding to the pus a little watery methyl-blue a few unstained granular degenerate amœba-like cells were found, similar to amœba which have been subjected for a short time to the action of a very dilute solution of emetine. These observations left no doubt in my mind that every amœba in the liver had been killed by the emetine injected subcutaneously during life, as the body was fresh and the temperature very favourable for the preservation of the parasites. Moreover, sections of the walls of some of the smaller abscesses stained with hæmatoxylin also showed no amœbæ, although they are readily demonstrated in this way when emetine has not been used in the treatment.

" This case, taken with another recorded, appears to me to afford strong evidence that emetine salts administered hypodermically in sufficient doses will kill all the amœbæ in both the intestinal and liver abscess-walls, and thus explains the extraordinary results recorded in this and my former paper, and affords good hope of even more uniform success in the treatment of the deadly and wide-spread amœbic infections when the new method is fully worked out and the most useful and safe doses ascertained. The following cases will serve to prove that emetine is also of great value in the treatment of amœbic abscesses of the liver and spleen, and is likely in the near future to save a large proportion of these unfortunate patients from the surgeon's knife."

CASE 2. *Epigastric Liver Abscess cured by Aspiration and Emetine Injections after Failure of the Quinine Treatment.* A native lad, aged 15, admitted for a liver abscess bulging in the epigastric region. Six ounces of liver pus were removed by aspiration, and 1 oz. of saline containing 10 grains of the soluble bihydrochloride of quinine injected into the cavity, and the puncture sealed with collodion. Intermittent fever continued and the abscess cavity refilled within four days. A second aspiration was now done, 8 oz. of liver pus being removed, and 1 grain of emetine hydrobromide, dissolved in 2 oz. of sterile salt solution, was injected into the cavity. The emetine salt was also injected subcutaneously in ½-grain doses every morning for four days, and again on the sixth day. In addition, 10 grains of ipecacuanha were given by the mouth every evening. After two days the temperature fell to normal and never again rose above 99° F. The abscess cavity steadily contracted and the tissues became firm, and he was discharged cured just under one month after the emetine injection, having been detained under close observation to make sure that the abscess did not refill. This case is one which would, in all probability, have done well by the open operation, as the abscess was a comparatively small one, but the rapid subsidence of the fever and cessation of formation of pus under the influence of emetine was very striking.

CASE 3. *Right Lobe Liver Abscess cured by Aspiration and Injection of Emetine.* A native male, aged 30, admitted for liver abscess following dysentery six months before. On aspirating through a lower right intercostal space, 8 oz. of typical liver abscess pus were withdrawn and 1 grain of emetine hydrobromide dissolved in 2 oz. of sterile salt solution injected into the cavity and the puncture wound sealed with collodion. Half-grain doses of emetine were injected subcutaneously on each of the four following mornings and 25 grains of ipecacuanha given in the evenings, my supply of emetine being then very limited. The temperature rapidly fell to normal, but

on three occasions during the next thirteen days it reached 100° F. in the evening. At the end of this time the liver was normal in size and there were no signs of further collection of pus, but to make quite sure a second exploration under an anæsthetic was now performed, with a negative result, and subsequent convalescence was only interrupted by a mild attack of benign tertian malaria.

" In addition to the above cases, a third, very similar to Case 3, has done equally well, but it is yet too early to be certain of his permanent cure. On the other hand, in two others the pus obtained at the time of aspiration and injection of emetine was found on culture to contain large numbers of staphylococci, and consequently the abscesses had to be opened and drained, with ultimate recovery. I have previously pointed out, in connection with my method of treating amœbic liver abscesses by aspiration and injection into the cavities of soluble quinine salts, that such a plan should only be persisted with if the pus is free from marked secondary bacterial infection, as is the case in 85 per cent. in my experience."

" *Amœbic Liver Abscesses cured by Aspiration and Subcutaneous Injections of Emetine.* In two other cases, one of which is still under observation, liver abscess pus was evacuated by aspiration and emetine injected subcutaneously, but not into the abscess cavity. In one the emetine injections were given for acute hepatitis, which greatly improved, but as leucocytosis persisted, the liver was explored and several ounces of pus withdrawn, after which steady convalescence ensued and the leucocytosis disappeared. In the other the emetine injections were commenced two days after the aspiration of liver pus, with an equally happy result. A single aspiration so exceptionally cures such cases that these two successive recoveries are in all probability due to the action of the subcutaneous injections of emetine in destroying the amœbæ in the walls of the liver abscesses, so it may eventually prove unnecessary to inject the drug into the cavities ; although in view of the harmlessness of the procedure, and the certainty that it will kill the parasites in the superficial parts of the lining membrane, it is advisable to do so in the present state of our knowledge.

" Taken as a whole, the cases above detailed of amœbic abscesses of the liver and spleen treated by emetine injections are full of promise. If further experience should confirm them a new era will be commenced in the treatment of this very serious and fatal disease, for the causative parasite can be destroyed by injections of emetine salts into the abscess cavities, after very thorough evacuation of their contents by aspiration and subcutaneous injections of the same drug will kill the organisms in the deeper layers of the abscess wall through the blood stream (as well as in any latent amœbic ulcers in the large bowel which may have produced the liver trouble), and thus the necessity of resorting to the much more serious and exhausting open operation and prolonged drainage, with the almost inevitable secondary bacterial infection of the wound in damp hot climates, may be largely done away with, greatly to the comfort and benefit of the patients.

" *The Disappearance of Leucocytosis as Evidence of the Cure of an Amœbic Abscess of the Liver.* When using the above method it is often difficult to decide if the abscess is completely cured, or if some pus has again accumulated, necessitating a further aspiration. Here leucocyte counts are of great value, for I have frequently found that if an original actual or relative leucocytosis has not disappeared within about a fortnight after an aspiration, pus will usually be again found on exploring ; while

if the original increase in the white corpuscles has vanished, the abscess is really cured, and further aspirations are negative, although usually harmless."

ASPIRATION AND SIPHON DRAINAGE

Mr. James Cantlie from his great experience strongly recommends this method, which is safer than an open operation. It calls for less operative skill and can be adopted with comparative safety under circumstances which are unfavourable for a major operation. For these reasons it can be applied without the delay that is otherwise unavoidable. The medical attendant often alone in a remote tropical region may shrink from submitting the patient to a difficult operation, or from performing it himself under adverse circumstances. On the other hand much time is wasted before the patient can be moved to an operating centre. The method is particularly suitable for deep-seated abscesses, especially in the supra-hepatic region, for in this way these abscesses can be found and evacuated early, and long before they assume a great size at the expense of the liver tissue and general health, and before they bulge or burrow to the surface.

Operation. As soon as an hepatic abscess is strongly suspected, and emetine injections have failed, the liver is explored as already described and, if possible, under an anæsthetic, so that this can be thoroughly done. Failing a general anæsthetic morphia gr. $\frac{1}{3}$ and scopolamine gr. $\frac{1}{100}$ should be injected an hour before the exploration and novocaine used locally. In all cases the surgeon must be prepared to evacuate the pus at once, otherwise the contents of the abscess, often under great tension, may escape into the peritoneum through the track of the needle. The skin is incised for three quarters of an inch at the site of the puncture, and the trocar and cannula four and a half inches long and one third of an inch in diameter is plunged into the abscess along the track of the exploring needle. As the trocar is withdrawn and pus escapes, the end of the cannula is closed with the thumb until a rubber tube can be introduced. It is better for the pus not to escape too rapidly, and it is necessary to prevent the entry of the air which interferes with the siphonage. The rubber tube, which is about nine inches long and has been boiled, is somewhat larger than the cannula so that it fits snugly into the puncture in the liver. It is necessary to stretch the tube before it can be introduced. This is done by threading it over a metal rod with a hook at one end. Two side holes are made near the inner end of the tube for better drainage. When the tube has been introduced well into the abscess, first the cannula and then the metal rod are withdrawn. About four inches of the tube now project, and the end of it is at once attached to a glass tube connected with another piece of tubing long enough to reach the bottom of a vessel on the floor near the bed. The end of the tube is weighted and kept under the surface of an antiseptic solution, otherwise proper siphonage is impossible. The tube is sewn to the skin to prevent it slipping out. Drainage is continued as long as pus escapes.

In many cases it is to a free incision, however, that we must look for a permanent cure. This may be employed in three ways :

(1) Direct incision and drainage, when tenderness, œdema, and redness make it probable that adhesions exist. This needs no further comment. (2) Incision and drainage by abdominal section in two stages. (3) Incision and drainage by abdominal section at one sitting. When the

patient is anæsthetised immediately before the operation, in doubtful cases, the liver should be explored with an aspirating needle of medium [1] calibre and four and a half inches long over any suspected area or through the ninth intercostal space in the axillary line, about an inch above the costal margin and therefore below the pleural reflection. The needle is passed upwards and backwards as well as inwards, for the abscess is usually in the upper and back part of the right lobe of the liver. If pus be found the operation should be at once proceeded with.

The methods of treating an hepatic abscess by abdominal section, whether in one or two stages, have already been spoken of at p. 450 under the heading of Hydatids. They have the following advantages over other modes of treatment : (a) The benefit of a free incision and thorough drainage ; (b) the surgeon can see what structures he is dealing with ; (c) bleeding from the liver can be seen and arrested ; (d) pus can be prevented from escaping into the peritoneal sac by packing, &c.

Very little need be said here of the treatment by abdominal section in addition to that already written at p. 450. In the two-stage method the surgeon will open the peritoneal sac, suture the parietal peritoneum to the edges of the wound, insert some gauze, and endeavour, by well-adjusted bandaging, to keep the abdominal parietes in contact with the liver, opening the abscess on or after the third day.

In the method by direct incision, a free incision of four or five inches is made and the peritoneum opened. The position of the pus having been verified by a fine trocar or aspirator needle, tampons of gauze are carefully packed around, or better, the parietal peritoneum is sewn to the liver around the site chosen for the incision. The abscess is then incised, and the opening at once plugged, and freely dilated with the finger. Any escape of pus into the peritoneal sac is prevented (1) by careful preliminary suture ; (2) by the careful packing ; (3) by the finger hooking up the liver against the wound ; (4) by an assistant keeping the parietes steadily against the liver. Hæmorrhage is controlled by forceps or sponge-pressure. When the abscess is empty [2] its opening is plugged with a sponge, and the liver and the parietes being still kept accurately together, the tampons first inserted are removed, and the edges of the liver wound stitched, with catgut passed with curved needles on a holder, to the edges of the abdominal incision, care being taken to keep peritoneal surfaces well in contact. Spittell [3] very candidly records death from peritonitis following the removal of the tube before firm adhesions had protected the peritoneum. A large rubber tube is passed into the abscess cavity and fixed to the edges of the parietal wound by suture. Care must be taken not to pass the tube too far in lest it cause sloughing from pressure upon the wall of the abscess, which may be thinly separated from the peritoneum in places. A considerable thickness of dry gauze dressings will be needed at first, and will require frequent renewal. This will be facilitated by the use of a many-tailed bandage.

[1] It is essential for the needle to be of good size to allow the rather thick pus to flow. Sir Patrick Manson advises that, " at least, six punctures be made before the attempt to find it is abandoned " (*Tropical Diseases*, p. 369).

[2] The late Mr. Greig Smith (*Abdom. Surg.*, p. 527) advised that, if the abscess does not empty itself readily, a large tube lying in carbolic lotion may be pinched at the end, and when placed at the bottom of the abscess will act as a syphon. He also draws attention to the need of exploring the abscess cavity for signs of a second abscess, and, if this be found, opening it with the finger or dressing-forceps. All manipulations now must be of the gentlest for fear of hæmorrhage.

[3] *Brit. Med. Journ.*, October 25, 1913.

Treatment of Cases of Hydatid or Abscess of the Liver which have opened, or which threaten to open, into the Chest. I refer here to those grave and difficult cases where a hydatid cyst or hepatic abscess, instead of making its way towards the abdominal wall, works upwards, thrusting up the base of the lung. Perhaps the first few tappings have drawn off fluid from the front, but after this the cyst recedes from the epigastric region as in Mr. Owen's case.[1] In other and rare cases the cyst or abscess has been opened from the front or the side through the abdomen, but insufficient drainage is thus given. In such cases the advice given on p. 450 must be set aside, and the fluid must be drained through the chest, and below the pleura if possible, in order to avoid the development of
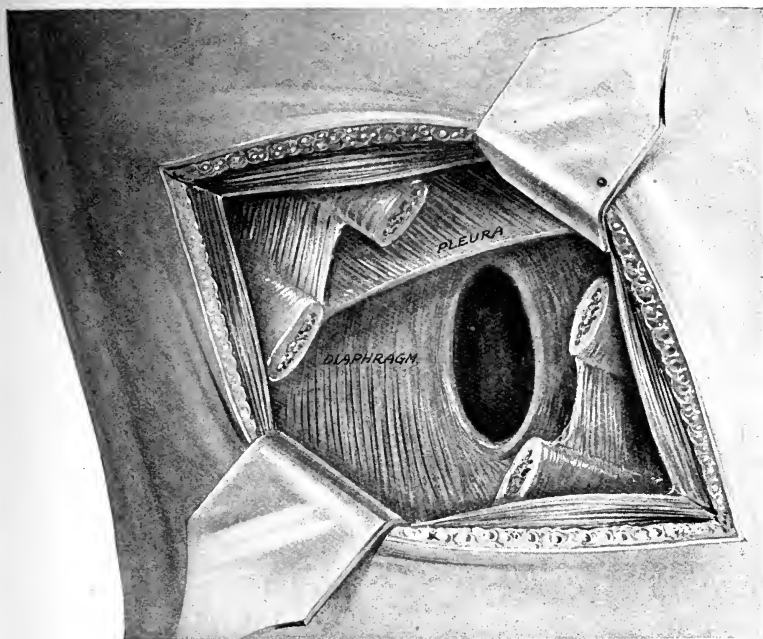
FIG. 215.   Operation for hepatic abscess from behind below the pleura.

pneumothorax, and lessen the risk of infection of the pleural cavity (Fig. 215).

The pleura may be already adherent in suppurative cases, and this may be indicated by the entire absence of breath and voice sounds and resonance over the lower part of the right lung. Under these circumstances the pleura may be disregarded. It may be remembered that the lower reflection of the pleura forms an oblique line running a little below the sixth rib in the nipple line, the eighth rib in the axillary, the tenth in the parascapular, and the eleventh at the spine. An incision may be so arranged that a portion of one or more ribs or cartilages may be removed and the liver exposed through the diaphragm below the pleural reflection, which may be displaced upwards if necessary. The same plan may be adopted also in the treatment of subdiaphragmatic abscess as recommended by Elsberg.[2]

[1] *Loc. infra cit.*   [2] *Ann. of Surg.*, vol. xxxiv, p. 729.

Mr. Godlee sutured the diaphragmatic and costal layers of pleura [1] round the edge of an aperture, made by removing a portion of rib, and then opened an hepatic abscess. Mr. Thornton, treating a similar affection with a view of obtaining a funnel through the pleura, along which the pus could escape safely, first raised the parietal pleura all round, so as to get a little free edge, then made a very careful longitudinal incision through the visceral pleura, raised it all round, and then with a fine curved needle united the two layers with a continuous fine silk suture. A channel being thus made, the liver abscess was opened by a curved trocar, the puncture converted into an incision, and a large drainage-tube inserted. Mr. Owen, in the case of a hydatid cyst which encroached upon the thorax, incised the eighth intercostal space, first behind the anterior axillary line. As soon as the costal pleura was divided, air rushed freely in with a very audible sound, and, the finger being introduced, the diaphragm was at once felt bulging up along the inner surface of the ribs, while the lung had retired beyond reach. The intercostal space, which was fairly roomy, was forcibly widened, but it was not thought necessary to excise a piece of rib. The phrenic pleura and the diaphragm were then carefully incised, and the abdominal cyst was discovered. A certain amount of its contents was withdrawn by aspiration, so as to relieve its tension, and to permit of some of the face of the sac being drawn through the diaphragm, and across the shallow pleural cavity to the skin wound, to which it was secured. The serous surfaces thus placed in contact were found firmly adherent on the fourth day. An incision was then made into the cyst and a drainage-tube inserted. All three patients recovered. To avoid collapse of the lung with cardiac failure from opening the pleura, the intra-tracheal method of administering ether is very valuable.

REMOVAL OF PORTIONS OF THE LIVER FOR NEW GROWTHS

Indications. This operation will always remain a rare one from the infrequency of growths which admit of removal. In the majority of cases a definite tumour has been felt in the liver before operation, but in some the tumour is only discovered or proved to be hepatic after the abdomen has been opened. The possibility of syphilis should always be borne in mind and the Wasserman reaction tested before exploration of a hepatic tumour. After the abdomen has been opened it may be difficult to distinguish between innocent and malignant tumours without micro-scopical examination, and for this purpose a small wedge-shaped portion may be excised and immediately examined and the report obtained within five minutes, so that the exact nature of the operation, if any, may be decided. In the same way inflammatory tumours such as gummata and tuberculous masses may be definitely identified. It may be superfluous to say that gummata do not call for removal but are best treated medically. To be removable a tumour must be primary in the liver, of moderate size and solitary, or confined to a part easy to remove such as the left lobe. It should have a fairly definite edge and not be infiltrating, so that it can be ascertained beforehand that the whole of the tumour can be removed with a good margin of healthy tissue around it. It is unnecessary to re-move simple growths if they are not doing any harm or likely to become

[1] Mr. Godlee (*Brit. Med. Journ.*, 1887, vol. ii, p. 872), Mr. K. Thornton (*ibid.* 1886, vol. ii), Mr. Owen (*Clin. Soc. Trans.*, vol. xxi, p. 78), and others have successfully adopted this course.

harmful. Similarly it is rarely necessary to remove a Reidel's lobe discovered during an exploration. The temperature is often raised by growth of the liver, and this has often led to a diagnosis of hepatic abscess.

Operation. The chief difficulty met with is hæmorrhage; this has, however, been satisfactorily controlled, either by (1) *isolating the tumour by means of an elastic ligature or sutures before removal,* or by (2) dividing the liver-substance with *the cautery, and ligating any large vessels met with while this is being done.* The portal vessels should be clamped during the removal, but the clamp should not be applied longer than is absolutely necessary.[1] Keen removed a carcinomatous left lobe weighing one pound and five ounces from a man aged 50, by the latter method, which he describes as follows :

" The operation was done entirely with the Paquelin cautery. It took from twenty to thirty minutes to sever the left lobe from the remainder of the liver. The hæmorrhage was not very severe, excepting when I burned into some of the larger veins. Each of these, when opened, I was able instantly to close by my left forefinger. Then, temporarily laying aside the cautery, I passed a catgut ligature under each by means of a Hagedorn needle, and one of my assistants tied it slowly but firmly. Five ligatures were thus applied. Three of the veins required ligatures of both of the divided ends. The hæmorrhage, except from these large veins, was arrested by the Paquelin cautery, except that occasionally, when I laid aside the cautery to apply a ligature, temporary packing with iodoform gauze was of great service in arresting the parenchymatous hæmorrhage." The cavity left was partially occluded by means of sutures, the remainder being loosely packed with gauze. Complete recovery took place.

In other cases the charred surfaces after suturing have been treated without drainage without any untoward result.

When the elastic ligature is employed, long steel pins are so placed as to prevent the ligature from slipping, and the tumour then removed half an inch beyond the ligature. The wound is then closed round the stump, which must be carefully kept aseptic. In a case treated successfully in this way by Mayo Robson, the pedicle left was as thick as the wrist, and after the separation of the slough a granulating surface was left. This gradually contracted, and the patient made a good recovery. One of the best ways of preventing hæmorrhage is to isolate the growth by means of stout catgut ligatures passed through and through the liver around the growth before the latter is excised (Anschultz).

McWilliams[2] reports twenty-five cases of malignant disease of the liver submitted to operation. In eight cases there was fever before the operation, and this led to an erroneous diagnosis of abscess of the liver in three cases. Keen[3] has collected no less than seventy-four cases in an important paper from which most of what follows has been gathered. The mortality has so far been only 14·9 per cent., so that the risk of the operation is certainly not a very serious one. Some idea of the variety of tumours that have been removed from the liver may be obtained from the following list which Keen gives : Constricted, accessory, or herniated left lobe, five cases ; syphiloma, twelve cases ; carcinoma, seventeen cases ;

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[1] Pringle (*Ann. of Surg.*, October 1908), and McDill (*Journ. Amer. Med. Assoc.*, 1912, vol. ii, p. 1283).

[2] *New York Med. Journ.*, December 7, 1907.

[3] *Ann. of Surg.*, September 1899, p. 267.

adenoma, seven cases ; sarcoma, five cases ; angioma, four cases ; caver-
noma, one case ; cystoma, one case ; angio-fibroma, one case ; small
calculi, one case ; endothelioma, one case ; hydatid cysts, twenty
cases.

Anschultz[1] in 1903 analysed the records of ninety-six resections of
new growths of the liver.   Seventeen died from the operation ;   ten were
treated by excision, tamponade and pressure with one death ;   for seven
the thermo-cautery was used, and all recovered.   Of twenty-five in which
deep ligation and excision were adopted, two died.   And out of six in
which preliminary clamping was used, two died.   Of twenty-one done by
intrahepatic ligature and excision, six died ;   and of twenty-four in which
the elastic ligature was used, six died.   In $12\frac{1}{2}$ per cent. of the cases the
resected mass was gummatous ;   two of these patients died.   The ultimate
results of resections for malignant growth have been very poor except
in a few cases, only temporary relief having been afforded, and some delay
of death in those who have survived the operation.   To excise a gumma of
the liver is both unnecessary and unjustifiable, except perhaps in some
cases, where preliminary treatment with iodides and exploratory opera-
tion have failed to indicate the true nature of the tumour.   Lockwood
has successfully removed a Reidel's lobe for the relief of pain.[2]

Ransohoff[3] excised a mass from the liver, which, upon microscopical
examination, proved to be tuberculous.   The elastic ligature was used, but
this cut into the liver and caused profuse hæmorrhage next day.   The
growth was then removed with the cautery.   The patient died a few days
later of hæmatemesis of uncertain cause.

THE SURGICAL TREATMENT OF CIRRHOSIS OF THE LIVER WITH ASCITES—EPIPLOPEXY

Professor Talma was the first to suggest this operation in 1889, " but
to Mr. Rutherford Morison belongs the credit of having brought the
first case to a successful issue.[4]

Mr. Morison was quite unaware that any one had previously suggested
and already performed the operation when he first tried it, and published
his paper in the *Lancet* of May 27, 1899.

In a later contribution [5] Mr. Rutherford Morison gives the following
account of the way in which he was led to operate.

" I can now only claim, for Dr. Drummond and myself, that our
views and treatment were entirely independent and original.   His
belief was that in certain cases of cirrhosis of the liver, ascites might
be prevented by an increased circulation through the enlargement of
normal channels between the portal and systemic veins.   Mine, that
if his explanation was correct, it might be possible to cure ascites by
the formation of a new and accessory circulation, for which purpose I
devised the operation described."

The normal communications between the portal and systemic veins are
not at all free, and are practically limited to two situations : (a) Between
the gastric and œsophageal veins at the cardiac end of the stomach, whereby
blood may flow from the portal system into the azygos veins and superior

[1] Quoted by Haubold (*Ann. of Surg.*, 1904, vol. i, p. 243).
[2] *Lancet*, July 25, 1903.   [3] *Med. News*, April 16, 1904.
[4] Frasier, *Amer. Journ. Med. Sci.*, December 1900.
[5] *Ann. of Surg.*, vol. xxxviii, p. 360.

vena cava. Sometimes these veins may greatly enlarge in alcoholic cirrhosis, and may rupture into the œsophagus and lead to fatal hæmorrhage.

(*b*) Between the superior hæmorrhoidal tributaries and those of the middle and inferior hæmorrhoidal, whereby portal blood may reach the iliac and even the axillary and subclavian veins through the superficial and deep epigastric veins.

So far there is very little evidence that any considerable venous anastomosis takes place through the adhesions formed between the omentum, liver, or spleen and the parietes, although it is stated that "in the case operated upon by Lens venous channels were easily found in the new adhesions which had formed between the omentum and the parietal peritoneum.[1]

It is more than probable that any good which may follow the operations which have been designed for establishing vascular anastomosis is really due more to the drainage carried out at the same time, and to the interference with the secreting function of the hepatic and splenic peritoneum.

Indications. In view of some undoubted recoveries which have followed it, the operation of epiplopexy is certainly worthy of consideration, especially when the grave prognosis of alcoholic cirrhosis under medical treatment is remembered. It is a mistake to think, however, that the disease is always fatal even after ascites has developed, and recovery may follow paracentesis in a few cases.

Epiplopexy should certainly be reserved to early cases either before or soon after the onset of ascites ; and in the absence of general debility cardiac or renal disease and jaundice. Immediate cholæmia and early death followed the operation in an early case under the care of Dr. Fawcett, at Guy's Hospital. The patient seemed to be a favourable one for the operation, which was performed soon after the development of ascites. And in many other cases the results have been the same. Death may occur from shock, cholæmia, infection, or exhaustion.

If the operation is advised at all, the immediate dangers and the poor prospect of permanent relief should be honestly explained to those who have the ultimate responsibility of deciding for or against it.

Operation. The abdomen is opened under general or local anæsthesia ; the latter is not sufficient in some cases, but the former is especially dangerous in these cachectic patients. The incision is made above the umbilicus and near the middle line, a valvular wound being adopted. The fluid is drained and mopped away until the peritoneum is quite dry. As far as possible the peritoneal surfaces of the liver, spleen, and parietes are roughened by gauze friction, and the great omentum is extensively sutured to parietal peritoneum which has been rawed by friction. Catgut is the safest suture material to use. Drainage may be established through a stab-wound carefully made above the bladder and pubis, but unless great care be taken this may lead to septic infection sooner or later, and for this reason some surgeons prefer to dispense with it. The upper wound is carefully sutured in overlapping layers in order to avoid ventral hernia.

The omentum has been fixed in the parietal wound in some cases, but this is not to be recommended on account of the danger of hernia. Schiassi makes a vertical incision a little below the left costal margin opposite the middle of the clavicle, and another one running outwards

[1] Moynihan, *Abdominal Operations.*

from the upper end of the first incision. A triangular flap consisting of all the tissues down to the peritoneum is then raised, and a vertical incision made in the peritoneum. The spleen and great omentum are withdrawn sufficiently to allow the surgeon to fix them in the wound, which is then sutured.

Results. Mr. Morrison's first case, like others before it, was unsuccessful, but the next, a woman, was relieved of her ascites and survived for two years, when she died from an operation undertaken for ventral hernia, the result of the former operation. Another successful case recorded by the same surgeon is quoted in detail below. Sinclair White also records two successful operations, both the patients being well a year after the operation.[1] On the whole, however, the operation cannot be said to have been a success. Out of 105 cases collected by Greenough, the mortality was 29·5, and only nine showed improvement after two years.

Out of six cases recorded by Harris five died within a month of the operation, and the other one, probably a syphilitic case, was alive but unrelieved after five months. It is fair to state that all these patients were in advanced stages of their disease at the time of the operation.

Koslowski found that 46 per cent. of 168 cases were either improved or cured after the operation.

Monprofit (quoted by Moynihan) collected 224 cases, in 213 of which the results were known. About 20 per cent. died from the operation, and about 20 per cent. died subsequently from cachexia or concomitant disease. Recurrence of the effusion took place in about 12 per cent. Improvement occurred in a little over 12 per cent., and recovery in about 33 per cent.

It may be safely concluded that these results, which refer to published cases, are far better than the real results of the operation, many failures being, as usual, buried in oblivion.

There is not enough evidence available at present to enable us to arrive at any accurate conclusion concerning the place and value of this operation, which is still decidedly upon its trial.

The following is a case of undoubted cirrhosis of the liver, in which a brilliant recovery followed an operation by Mr. Rutherford Morison :

The patient was an alcoholic man, aged 52, who had been tapped 14 times, 18 gallons and 2½ pints of fluid having been withdrawn in all, but without any permanent relief. Medical treatment and paracentesis having failed, the patient was admitted into the surgical wards of the Royal Infirmary, Newcastle-upon-Tyne. The following account is taken from the *Ann. of Surg.*, vol. xxxviii, p. 360 : " On admission to the surgical ward his condition was described as follows : He was a thin man with sallow complexion, sunken cheeks, and yellow-tinted conjunctiva, his tongue was clean and moist, appetite fairly good, arteries slightly atheromatous, pulse ninety-two, and temperature normal. No jaundice or other disease discovered beyond what follows. His abdomen was much distended, and the physical signs were those of a large collection of free fluid ; the left side of the scrotum was swollen from fluid distending a hernial sac. Dilated subcutaneous veins were visible, starting from the neighbourhood of the umbilicus, and terminating in one large trunk on either side, which ran up over the chest into the axilla. The direction of the blood current was ascertained to be from below upward. Percussion showed an increased splenic and diminished liver dulness. There was some œdema of the feet and legs extending as far as the middle of the calf. On August 29, 1899, the patient was operated upon, under chloroform. An incision about four inches long opened the abdomen between the ensiform cartilage and the umbilicus. The subperitoneal fat was vascular, and bled freely. A large amount of clear straw-coloured fluid escaped as soon as the peritoneum was divided. A second opening was next made between the umbilicus

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[1] *Brit. Med. Journ.*, October 10, 1903.

and the pubis large enough to admit a half-inch diameter glass drainage-tube, which passed through and into the pelvis. Some adhesion was present between the liver and the omentum, and between the omentum and the abdominal wall. The liver was firm, finely granular on the surface, and of about normal size. The spleen was hard and enlarged to at least double its normal size. The abdominal cavity was dried with sponges, special care being taken to rub the surface of the visceral peritoneum opposed to them. The omentum was fixed across the anterior abdominal wall by catgut sutures. The upper incision was entirely closed by catgut sutures. The lower was kept open for a drainage-tube, through which the fluid was pumped out of the pelvis. Over the dressings, broad long strips of adhesive plaster were applied transversely from the chest above to the drainage-tube opening below. This was for the purpose of keeping the upper part of the abdominal cavity empty of fluid and the parietal closely applied to the visceral peritoneum.

" Two nurses, with a reliable knowledge of antiseptic wound treatment, were told off to look after the tube, and keep any fluid from collecting in the pelvis or from escaping on to the dressings. The operation was well borne, and his recovery straightforward." From ten to twenty ounces of fluid were removed daily for the next fortnight or more, but on October 10 the tube was left out, for there was no fluid coming through it. Three weeks later he was readmitted and 230 ounces of liquid were removed.

" January 3, 1900 : Better ; signs of very little fluid in belly. From this date there was no further accumulation of fluid, and at the present time (February 1903) he is very well, never looked better, is fat and strong, and has a good appetite. There are no signs of fluid in the abdomen. The veins in the abdominal wall are very large ; he complains of some dragging pain in the abdomen ; the liver can be felt adherent to the abdominal wall " (note by Mr. G. Grey Turner, Surgical Registrar). This man was well several years later.

CHAPTER XXVI

OPERATIONS ON THE GALL-BLADDER

INJURIES OF THE GALL-BLADDER OR BILE-DUCTS

Indications. These are rare accidents and usually they are associated with other abdominal injuries. Subcutaneous rupture may be due to falls or blows upon the abdomen, and they are more likely to happen when the gall-bladder or ducts are distended from obstruction. The immediate results will depend a great deal upon the character of the bile, for if the latter is aseptic there may be no symptoms beyond some initial collapse for some days, whereas an acute spreading peritonitis soon follows extravasation of infective material. Often the abdomen is explored on account of associated injuries such as rupture of the liver, which causes hæmorrhage and collapse. The extravasated bile, if at first aseptic, later becomes infected from the intestine, and a plastic peritonitis ultimately results and generally leads to the death of the patient within two or three weeks. A great deal of lymph is exuded and this often serves to localise the extravasation in the right kidney pouch with the formation of a large cyst containing bile. In many cases there is some jaundice, especially when the main ducts are involved. Sometimes the extravasation and effusion are more general and enormous in quantity, giving all the signs of ascites.

Operation. There is no doubt that an operation should be performed as soon as the diagnosis is made, but in many cases this is difficult.

(*a*) *Aspiration.* Localised collections have been successfully treated by aspiration, which has had to be repeated as a rule on several occasions.

(*b*) *Laparotomy.* When the abdomen is opened the extravasated bile should be mopped up by means of gauze rolls passed in various directions, while the gall-bladder and its ducts are examined. If there is an opening in the gall-bladder, a tube should be secured in it as in the operation of cholecystostomy. This is generally simpler and safer than suture without drainage. An opening into one of the ducts may be treated in a similar way. If the common bile-duct is completely divided and if the two ends can be found, they should be brought together as far as possible and a tube inserted into the remainder of the opening, but if it is impossible to bring them together, a rubber tube may be sewn into the upper end of the duct and its other end may be implanted into the duodenum or stomach after the manner of Witzel's gastrostomy. The omentum is then sutured around the tube and ultimately forms the wall of the new duct after the rubber tube has been discharged into the duodenum. Sullivan [1] has performed this operation

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[1] *Journ. Amer. Med. Assoc.*, 1912, vol. i, p. 2026.

successfully on animals and Wilms [1] has successfully performed a similar operation on five patients. Failing this the upper end of the duct may be ligatured and cholecystenterostomy performed.

OPERATIONS FOR GALL-STONES

Cholelithiasis is by far the commonest indication for exploring the gall-bladder and bile-ducts. Therefore it is necessary to consider briefly the different sites at which calculi are met, with the chief evidence of their presence and differentiation. It must be understood that several of the following conditions may co-exist causing a confusion of signs and symptoms.

(1) **The Stones are in the Gall-bladder.** The symptoms are (a) Recurrent attacks of pain in the right hypochondrium associated with vomiting and local tenderness. These attacks are often mistaken for gastritis. The gall-bladder may be feelable during the colic.

(b) A dull aching pain in the right hypochondrium and right shoulder, with a distaste for food. On deep inspiration there may be " a catch " or pain in the gall-bladder region, and local tenderness on palpation. No swelling may be feelable unless the cystic duct is obstructed or cholecystitis with local peritonitis develop. There is no jaundice unless the common duct also is obstructed.

(2) **The Stone or Stones are in the Cystic Duct.** There is colic at intervals with a swelling having the characteristics of a distended gall-bladder. Usually this is in the right hypochondrium, but it may reach the right iliac fossa. Jaundice is absent unless the stone is junctional and presses upon or otherwise obstructs the common or hepatic duct. The stone usually falls back and the colic abates after a few hours, but it may remain impacted and cause inflammation with suppuration, or even sloughing of the gall-bladder. Grey patches appear at the fundus of the gall-bladder or below the stone in the duct. Perforation may take place with local or general peritonitis, or adhesion to the duodenum, colon or stomach may take place with the formation of a fistula. It is still a common error to believe that gall-stones are unlikely without a history of jaundice, but it should be remembered that as the cystic duct is narrower than the common duct except at the papilla, more stones get impacted in the cystic duct than anywhere else, and that *jaundice is really an exceptional and late sign of gall-stones.* This error has condemned many patients to years of unnecessary suffering—a diagnosis of gastritis or hysteria being commonly made.

(3) **The Stone or Stones are in the Common Duct.** This, according to the duration of the mischief, is more or less dilated. In addition to colic, jaundice usually develops sooner or later, and fever is sometimes present during the attack of jaundice due to an ascending infective cholangitis. Sometimes stones impacted in the common duct do not cause colic, but generally there is nausea instead. There is often tenderness on deep palpation over the common duct. Small stones in a dilated common bile-duct, although they may cause frequent colic, may not obstruct long enough to produce jaundice. Therefore it is imperative to examine the common duct carefully in every case even when there is no history of jaundice. The gall-bladder, as pointed out by Terrier, Mayo Robson, and others, is usually contracted, shrunken and matted down by adhesions in

[1] *Berl. klin. Woch.*, 1912, 536.

these late cases, so that no gall-bladder swelling is evident.   In fact, *if the gall-bladder can be felt in a jaundiced patient, the obstruction is probably due to other causes, such as growth of the head of the pancreas or chronic pancreatitis.*   In these conditions the pain, although it may be severe, is rarely colicky in nature.   Moreover, the jaundice is gradual, progressive, and severe, and not sudden, remittent, or intermittent and moderate as it generally is with gall-stones.   Long continued and black jaundice is very rarely due to gall-stones.   The age, sex, and especially the general condition of the patient assist in the diagnosis, for with pancreatitis, and especially with malignant disease, the patient looks more ill and wastes more rapidly than with gall-stones.

It is of the greatest importance to realise that jaundice which is neither slight nor transient, and is therefore not catarrhal, calls for early exploration and treatment.   In this way only can such dangerous complications as infective cholangitis and post-operative hæmorrhage be avoided with certainty.   Sometimes it is advisable to wait a few days when there is fever due to an exacerbation of existing cholangitis, for it is safer to operate in a quiet period.   For obstruction of the cystic duct or neck of the gall-bladder, with distension of the gall-bladder, which is unrelieved within forty-eight hours, it is imperative to operate in order to avoid suppuration and its complications.

Very rarely stones may form in the hepatic ducts, but this is nearly always secondary to obstruction of the common bile-duct.   Even in the most simple cases some degree of adhesion from local peritonitis may be present, and in the more complicated cases the difficulties the operator may have to face may be extreme.   Some of these will be referred to later in the accounts of the various operations.   The following may be mentioned as some of the special complications of gall-stones that may call for surgical intervention : Empyema of the gall-bladder, abscess around the gall-bladder or bile-ducts, suppurative cholangitis, chronic catarrhal inflammation of the gall-bladder and bile-ducts, and phlegmonous cholecystitis.

An operation for gall-stones is usually, in the first instance, exploratory, the special operation which is called for being then carried out according to the conditions found.   The steps of the exploration will therefore be first described, and the details of the separate operations given subsequently.

As a prophylactic against the dangerous hæmorrhage which is liable to attend operations upon patients suffering from late jaundice, the subcutaneous injection of 20 to 30 c.c. of fresh horse or other alien serum about two hours before operation is valuable.   Calcium salts are of no use.   Careful ligation of every bleeding-point and accurate sewing are even more important safeguards.

Exploration.   In order to render the parts more accessible, a rubber pillow is placed under the patient's back at the level of the liver.   This brings the common duct two or three inches nearer to the surface, and also tends to open out the costal angle, and displace the intestines downwards away from the liver.   The patient's head is raised and his thighs somewhat flexed to relax the recti.   One of the following incisions is made use of : (1) A vertical one over the prominence of any swelling present, or straight down from the prominence of the cartilage of the ninth rib through the outer part of the sheath and fibres of the rectus muscle.   It should be five inches long to begin with, and should be prolonged down-

wards if more room is wanted for the exploration of the common duct. This incision, if the wound be widely retracted, will answer in nearly all cases. Where the adhesions are very difficult to deal with, or the patient is stout, more room may be obtained by continuing the incision inwards an inch below the margin of the ribs. Some or all of the fibres of the right rectus are divided.

(2) Dr. Bevan [1] prolongs the incision horizontally outwards at its lower end, but this step is rarely necessary.

In stout patients it is an advantage to make the wound in the skin
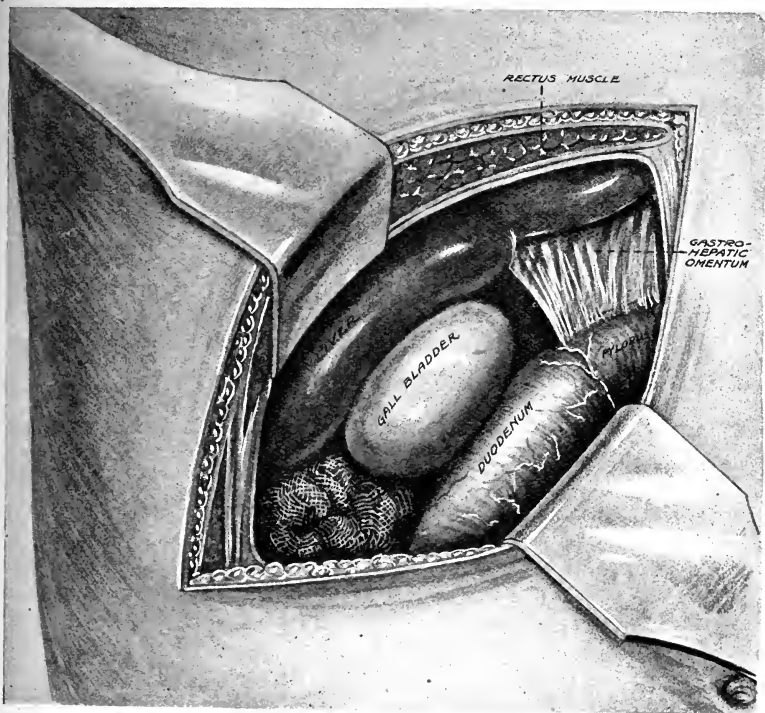
Fig. 216. Cholecystotomy. Kocher's oblique incision across the rectus.

and subcutaneous fat more extensive than the deeper part. The flabby superficial layers then fall away and diminish the depth of the wound.

(3) Professor Kocher uses an oblique incision about five inches long, running an inch and a half below and parallel to the costal margin, and with its centre a little external to the outer border of the rectus. This gives a very good view and, from its high position, it is not likely to be followed by ventral hernia, if care be taken in suturing, although the rectus fibres are cut across (Fig. 216). I like this incision and often use it for fat people. It is very convenient for drainage.

(4) Professor Perthes [2] makes a vertical epigastric incision just to the right of the middle line extending nearly to the umbilicus and cuts across the right rectus at this level, reflects the flap and divides the posterior wall of the rectus sheath below the costal margin.

[1] *Ann. of Surg.*, vol. xxx, p. 17.
[2] H. M. W. Gray, *British Journal of Surgery*, 1914, vol. i, p. 200.

Every bleeding-point is immediately tied with fine catgut. The posterior layer of the rectus sheath and the peritoneum are incised together without any attempt to separate them from one another. The abdomen is rapidly explored and the biliary apparatus examined as far as possible. A dry gauze roll is carefully packed into the right kidney pouch to catch any liquid that may be set free ; and an aseptic pad with tape attached is inserted at the inner part of the wound to protect the stomach and intestines.

Omental and other adhesions generally require separating, and in doing this great care must be taken to arrest all hæmorrhage and to avoid lacerating any of the adherent viscera. Gauze dissection is usually the safest and easiest method to adopt.

If possible, the liver should be pulled downwards and forwards into the wound, and then tilted so that its lower surface is displayed. The assistant should hold the tilted anterior border of the liver and the gall-bladder, while the surgeon examines the bile-ducts which are thus brought well forwards into view (*see* Fig. 217). A methodical and careful examination is then made of the gall-bladder and bile-ducts, and the exact nature of the operation to be performed is determined.

CHOLECYSTOSTOMY

If the gall-bladder is distended and free from adhesions, it is isolated by means of sterile gauze, then aspirated. But before it is empty any stone impacted in the cystic duct is gently squeezed back into the gall-bladder ; for it is far easier to do this now than when the gall-bladder is empty. If, on the other hand, the gall-bladder is small and shrunken and embedded in adhesions, these must be very carefully separated. In some cases the gall-bladder may be actually buried in adhesions, involving such structures as the abdominal wall, omentum, duodenum, and pylorus. A gauze pack must always be placed in the right kidney pouch, where any escaping liquid and blood will gravitate. While the adhesions are being separated the operator must be prepared in some cases for an escape of pus, which has been shut in by these adhesions, outside the gall-bladder. All pus is mopped away.

The gall-bladder is brought into the wound if possible, and having been isolated by means of gauze pads, it is first emptied by aspiration (*see* Fig. 218). The puncture is then enlarged and the gall-bladder held and steadied with forceps, while a forefinger is inserted to feel for calculi.

Any calculi which lie near the surface are removed with scoops or forceps. Where a stone impacted in the cystic duct resists all efforts at extraction from the gall-bladder by scoops or forceps, attempts must be made to push it up into the gall-bladder with two fingers of the left hand introduced into the abdomen below the duct. At the same time the scoop or forceps may be used with the right hand. If all attempts at removal or dislodgment fail, either the duct must be incised over the calculus, or cholecystectomy performed, according to the comparative ease and safety of these measures in the particular case.

Very rarely in grave cases, especially with suppuration, the surgeon will have to be content with drainage of the gall-bladder ; later the calculus may become dislodged spontaneously and be discharged externally. Injections have occasionally been successful in removing the

stone. If the mucous fistula persist and cause serious inconvenience, a secondary operation may have to be undertaken for its treatment, under more favourable circumstances.

To drain the gall-bladder a rubber tube of a quarter of an inch diameter should be passed into it for about an inch and fixed in position by means of a single catgut suture piercing the sero-muscular coats of the gall-bladder and the side of the tube. A purse-string or a continuous sero-muscular suture is then inserted and tied as the tube is pushed inwards. This procures inversion of the edges of the incision, the serous
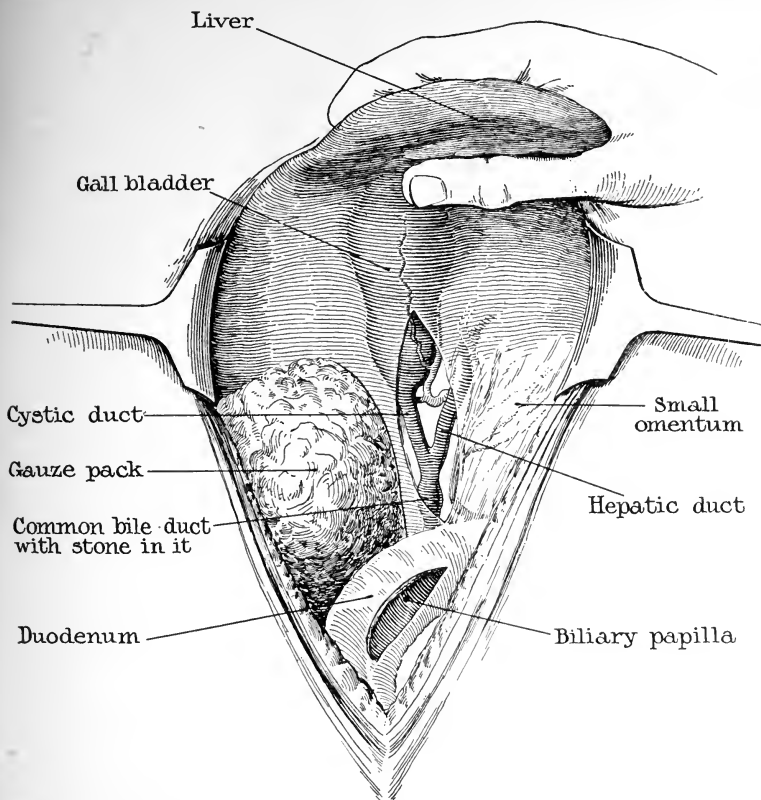
FIG. 217. Exploration of the biliary apparatus. Choledochotomy and duodeno-choledochotomy.

surfaces become approximated, and the tube is held firmly so that no leakage can occur. The peritoneal coat of the gall-bladder is then secured to the parietal peritoneum at several points, and the rubber tube is fixed to the cutaneous edge of the wound, in order to prevent its premature removal by any accidental traction upon it (see Fig. 219). The outer end of the tube is fixed in a bottle secured at the side of the patient. The tube loosens and comes away after about a week, and the fistula rapidly closes if there is no obstruction in the biliary passages.

Sometimes it is difficult or impossible to bring the gall-bladder up to the abdominal incision and suture it there. Then it is better to let it fall back into the abdomen than to fix it to the parietes under tension, for the latter may lead to kinking of the bile-ducts at the insertion of the

cystic duct, with complete or incomplete diversion of the bile into the fistula. There is no danger in letting the gall-bladder fall back if the drainage-tube has been properly fixed in a watertight manner. In doubtful cases a slit tube containing a wick of gauze is placed just below the gall-bladder to guard against all risk of leakage (*see* Fig. 220).

FIG. 218.

Often it is better to excise the useless and contracted gall-bladder, and this is all the more justifiable because the thickened wall may be already in an early stage of carcinomatous disease. Many cases have been recorded in which the gall-bladder has been discovered after its removal to be affected with malignant disease, although this was not
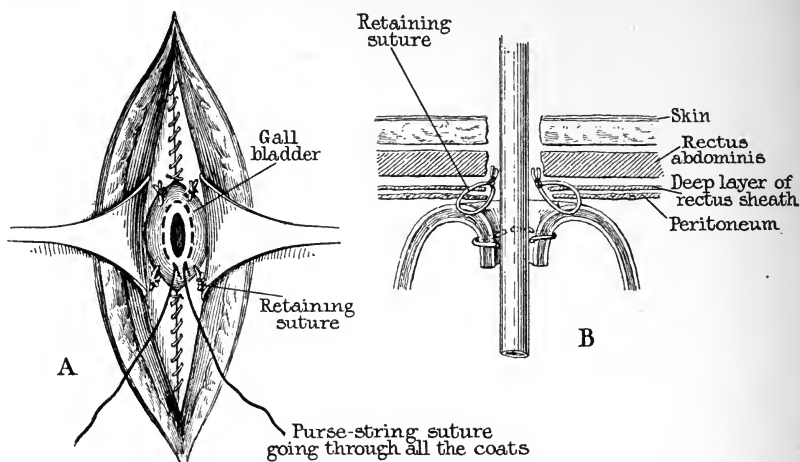
FIG. 219. Drainage of the gall-bladder and fixation to the parietal peritoneum.
(After Summers.)

even suspected at the operation. The packs are removed and the air is allowed to escape from the rubber pillow. The wound above and below the tube is closed in layers in the usual way.

CHOLECYSTOTOMY

Here the gall-bladder is completely closed after the extraction of the stones. This step has grave objections. (1) It is not so safe as cholecystostomy, owing to the risk of leakage if the walls of the gall-bladder are at all inflamed and softened. This is just an instance of an operation where we hear of the successful, but never of the unsuccessful cases. (2) It is not always easy to be certain that all the ducts are patent. If a stone be left behind, suturing and returning the gall-bladder will give rise, in the immediate future, to dangerous tension on the sutures by the back-flow of the bile, while it prevents the escape of the stone, blood-clot or infective material through the open gall-bladder. (3) When

the gall-bladder is left after the removal of gall-stones, drainage is essential for the successful treatment of the chronic or acute inflammatory conditions, which partly cause and partly result from the lithiasis. For these reasons the operation has been abandoned.
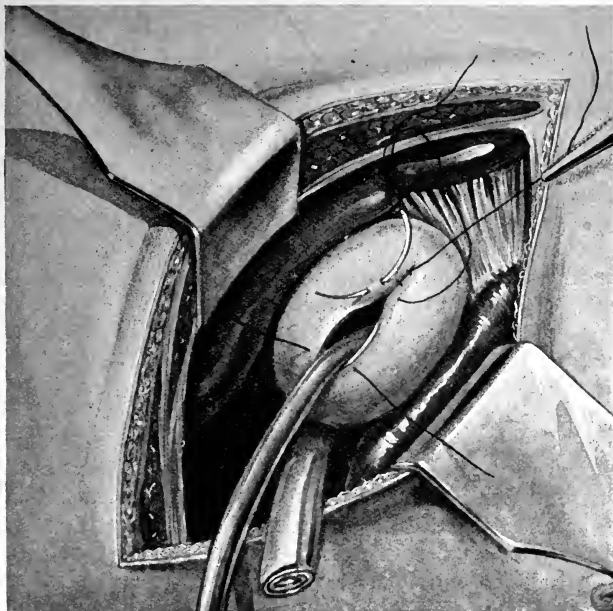
Fig. 220. Cholecystostomy. A rubber tube is fixed in the gall-bladder with a catgut suture. The incision in the gall-bladder is closed with investing sutures of catgut. A soft folded piece of rubber sheet or intestinal drainage tubing is used to drain Morison's Pouch. Both the drains are brought out at the inner angle of the wound, which is closed in layers.

CHOLECYSTECTOMY

The indications for this operation as given by Mayo Robson [1] are as follows : " (1) In bullet wound or other wound of the gall-bladder where suture is impracticable. (2) In phlegmonous cholecystitis. (3) In gangrene of the gall-bladder. (4) In multiple, or in perforating ulcers. (5) In chronic cholecystitis from gall-stones, where the gall-bladder is shrunken and too small to safely drain, and *where the common duct is free from obstruction.* (6) In mucous fistula due to stricture of the cystic duct. (7) In hydrops of the gall-bladder due to stricture of the cystic duct ; as also in certain cases where the gall-bladder is very much dilated. (8) In certain cases of empyema, where the walls of the gall-bladder are very seriously damaged. (9) In cancer of the gall-bladder." To avoid this, gall-stones should be treated with less delay, for their long-continued irritation very frequently leads to the development of carcinoma. (10) Volvulus of the gall-bladder may be added. Kubïg [2] records a case of this and found records of three others. (11) Kinking of the common duct with biliary fistula from traction following cholecystotomy is most certainly relieved by cholecystectomy if the common duct is clear.

[1] *Loc. supra cit.*   [2] *Münch. Med. Woch.*, 1912, p. 1999.

It has also been suggested by Moynihan and others that the gall-bladder should be removed in most cases of gall-stones, when it is certain that there is no obstruction of the common bile-duct.

Nearly all gall-stones are formed within the gall-bladder, and are secondary to pathological conditions chiefly affecting it. It seems to be reasonable to remove the source of the trouble with the object of preventing its recurrence, but true recurrence of gall-stones is an extraordinarily rare event. Dr. Mayo [1] in a review of 1500 operations upon the gall-bladder and bile passages found but one case of their own in which gall-stones re-formed in the gall-bladder. Stones which have been overlooked may be mistaken for recurrences. Schott [2] states that in only 5 per cent. of 180 cases from Czerny's clinic were there any biliary symptoms, and that in no case was a stone known to have formed, although the cases had been followed for about six years after the operation.

In many cases it is easier to remove the entire gall-bladder and the greater part of the cystic duct, than it is to extract the stones, which may be very numerous, and some of which may be overlooked in the cystic duct or elsewhere. In such cases the risk of infection is diminished, and the chance of recurrence is almost if not entirely abolished when the disease is limited to the gall-bladder.

Moynihan [3] draws attention to an interesting condition of the gall-bladder which demands cholecystectomy. Numerous very small stones are so embedded in the mucosa as to defy removal. I have seen one case of this kind; numberless small cholesterin calculi could not be scraped away from the excised gall-bladder without lacerating the mucosa.

The mortality of cholecystectomy is greater than that of cholecystostomy, even in skilled hands. Dr. Mayo writes : " Cholecystectomy has an increasing field of usefulness, but its increase of mortality, which, although slight, is for one reason or another fairly certain, prevents it from replacing cholecystostomy. At the same time, where the circumstances permit of easy removal of the gall-bladder and the disease is confined entirely to this organ, it is the operation we most commonly perform even in cases in which cholecystostomy would answer the purpose. But if the patient is very obese, and the gall-bladder has a broad attachment to the liver necessitating prolongation of the incision or increased manipulation, cholecystectomy is the more difficult and dangerous operation." For the majority of operators cholecystectomy is much more difficult and dangerous than cholecystostomy.

When the gall-bladder is removed, the need for drainage of the biliary passages is generally abolished, and the recovery of the patient is thus accelerated. Should drainage be called for, it can be established by tying in a rubber tube passed through the remains of the cystic duct, but this is neither so easy nor so safe as draining the gall-bladder. It is rarely wise to excise the gall-bladder after the removal of stones from the common bile-duct, especially if cholangitis exists, for secondary operations are more often needed for common duct cases than any others. Moreover, the gall-bladder may be useful later for drainage or cholecystenterostomy should there be future contraction and obstruction of the common bile-duct, and " it is also a safe guide to the deep ducts if future trouble should arise," [4] but stones in the common duct make excellent guides, and have afforded me sufficient assistance in three

[1] *Ann. of Surg.*, vol. xliv, p. 210.
[3] *Ann. of Surg.*, December 1909.
[2] *Beit. Z. Klin. Chir.*, 1903, xxxix, S. 427.
[4] Mayo, *loc. cit.*

such cases. In all of these the stones in the common duct had been over-looked at the time of the cholecystectomy. The writer had performed the first operation in one of these cases and had overlooked a very small faceted stone, which had never been impacted long enough to cause jaundice.

Another reason for removing the gall-bladder is that a thick-walled and contracted gall-bladder may be the seat of malignant disease which may only be discovered by microscopical examination after it has been removed. Dr. Sherrill [1] draws attention to the frequency of this com-plication in late cases, and advocates earlier operation in order to avoid it.

There is little or no real evidence that carcinoma may form after the
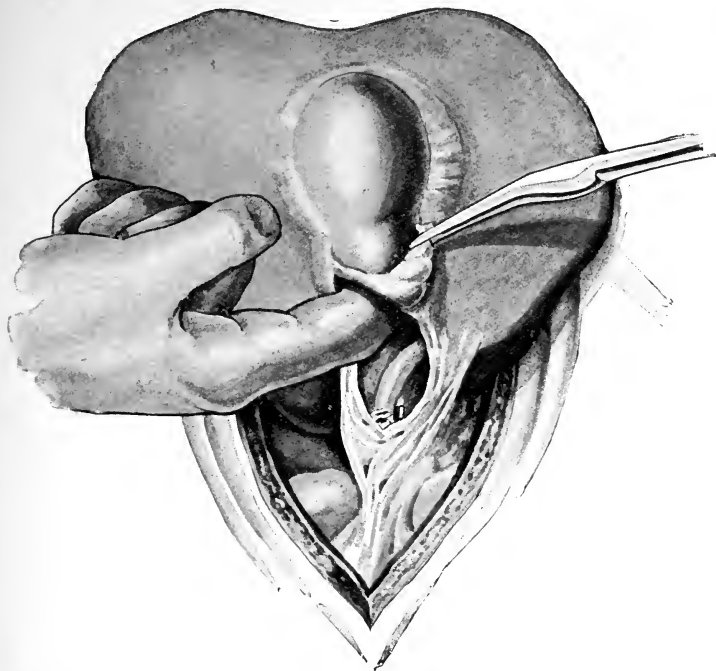
Fig. 221. Cholecystectomy. The cystic duct and artery are tied, the former as close as possible to its termination. The gall-bladder is being stripped up from the liver. The cut end of the cystic duct is closed by forceps. (Moynihan, *Abdominal Operations.*)

removal of the stones, but only that the disease may be overlooked in an early stage, while it is yet removable with hope of permanent im-munity from recurrence. Mayo mentions one patient who has survived for over three years after an early cholecystectomy for this condition. I have had a similar case. The growth removed about four years ago was quite small and was not suspected until the gall-bladder had been removed for multiple stones, one of which was impacted in the cystic duct.

Operation. The exploratory part of the operation has been already described at p. 468. When the gall-bladder has been carefully freed from adhesions, and the surgeon has decided to excise it after due consideration, the cystic duct is exposed by incising the peritoneum over it.

[1] *Ann. of Surg.*, vol. xliv, p. 866.

To avoid any possibility of a mistake, the point of meeting of the cystic with the hepatic and common bile-ducts must be seen (*see* Figs. 217 and 220).

The cystic duct is tied with catgut, and divided about a quarter of an inch from its termination between the ligature and pressure forceps, which prevent leakage from the gall-bladder and are useful for gentle traction. The stump is cleansed and any mucous membrane protruding beyond the ligature is removed with sharp pointed scissors. Later the stump is buried by sewing the peritoneum over it.

The cystic vessels are sought, and will be found usually a little above and to the left of the cystic duct, where they are ligatured and divided.
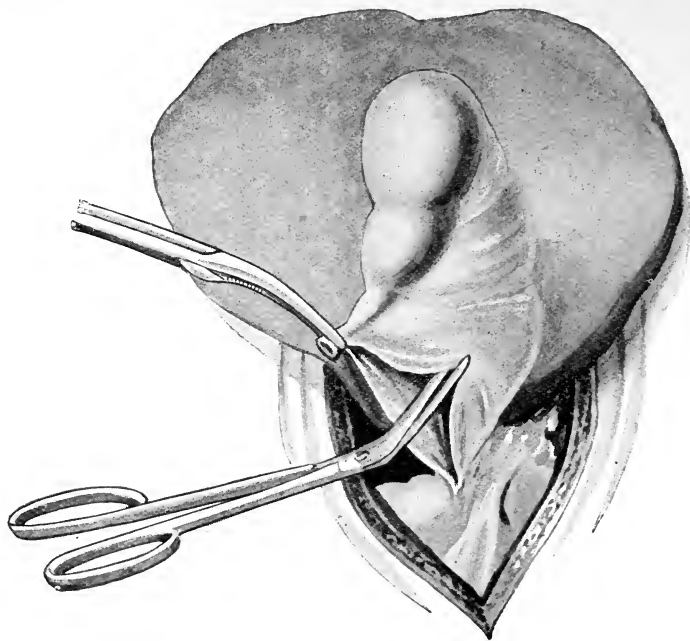
Fig. 222. Cholecystectomy. The peritoneum is being divided between the gall-bladder, which is partly stripped, and the liver. (Moynihan, *Abdominal Operations.*)

It is of considerable advantage to secure the pedicle before attempting to separate the viscus from the liver, so that blood oozing from the liver may not trickle back and obstruct the view; the bleeding is also lessened during the next steps.

The gall-bladder is now separated from the liver by blunt dissection from behind forwards. For this purpose the index finger may be passed between the gall-bladder and the liver as recommended by Moynihan (*see* Fig. 222).

The peritoneal covering is saved as far as possible until the separation is completed, and then it is so divided with scissors that the edges can be sewn together to cover the raw surface of the liver. This prevents adhesions and arrests hæmorrhage from the liver (*see* Figs. 222, 223).

Occasionally when there are dense adhesions it may be easier to separate the gall-bladder from before backwards. In a normal case

this will be simple, and all that is needful is to divide the reflection of peritoneum which passes from the liver over the gall-bladder, and then to shell out the latter from its fossa by gently tearing through the connective tissue and vessels which hold it in place, with the finger or a pair of curved scissors, these being used as a blunt dissector as well as to cut with. In cases, on the other hand, where there is much matting of the parts, the omentum, duodenum, colon, pylorus may all require most careful detachment, bit by bit, before the gall-bladder is reached, lying far from the surface, puckered and shrunken. And

when this is effected, repeated attacks of inflammation may have converted its immediate surroundings into a compartment of sclerosed fibro-fatty tissue out of which it has to be shelled like a kidney, the site of long-standing calculous pyelitis, from out of its thickened, matted capsule. Friability of the walls of the gall-bladder, these tearing away on the slightest traction, is another difficulty which may be very present with a deep-lying viscus. The gall-bladder having been separated as far back as the cystic duct, the first part of this is isolated, and its distal extremity tied with catgut.

Care must be taken not to include the hepatic, and still more the

FIG. 223. Cholecystectomy. The operation completed by suture of the peritoneum over the bared surface of the liver. (Moynihan, *Abdominal Operations.*)

common duct, in cases where the depth of the wound and adhesions may make the relations of parts uncertain. Before severing the duct it will be well, if two ligatures have not been passed, to close its proximal end with clamp-forceps so that no bile escapes when it is divided.

If it is not possible to bury the stump it may be treated with a little pure carbolic acid. When it is not possible to cover the raw surface of the liver with peritoneum, some bleeding, chiefly of the nature of oozing, occurs, and it is wise to drain the wound for thirty-six hours with a rubber tube containing a wick of gauze, but when no oozing takes place or soiling has occurred the abdominal wound can be safely closed without drainage.

OPERATIONS ON THE COMMON BILE-DUCT

CHOLEDOCHOTOMY

THIS term has been given to the operation of removing stones from the biliary ducts by direct incision. Usually the patient is jaundiced, but sometimes the obstructive attacks are so transient that jaundice is entirely absent. I removed three stones from the common bile-duct of such a patient, who for seven years had been seized with colic about once a week without jaundice at any time. She had had her gall-bladder removed seven years before I saw her, but the colic had continued. The colic ceased at once when the stones were removed. It seems clear that the stones in the common duct had been overlooked at the first operation.

The common bile-duct becomes smaller towards its termination, its diameter being about 8 mm. in the first part, 5 mm. in the second part, and $3\frac{1}{2}$ mm. in the intramural or third part, where it may be narrower than the cystic duct.[1]

In its first part the duct is fortunately near the free edge of the lesser omentum in front of the portal vein and to the right of the hepatic artery.

While the important relations of these ducts—especially the common—must always be remembered, the presence of the stone itself forms a reliable guide, as long as the incision is made directly over it. An inflamed or calcified lymphatic gland may be mistaken for a stone.

Operation. The preliminary exploration is described at p. 468, Figs. 216, 217.

(1) **Stone impacted in the First Part of the Common Bile-duct,** above the duodenum. The incision in the abdominal wall being lengthened if necessary so as to give satisfactory exposure of the parts concerned, the liver is tilted and held up, the edges of the wound are held widely open, and the position of the stone accurately defined. The area of the operation is then carefully shut off by sterile gauze packing, and any adhesions carefully separated by gauze dissection. All bleeding-points are ligatured at once. The left index finger is passed into the foramen of Winslow behind the first part of the duct, and the whole of the duct is carefully palpated as the thumb is moved down along the front of the duct as far as the duodenal papilla. A stone felt in the second or third part is pushed back into the first part if possible. The stone, firmly held, is raised as high as possible. The incision in the peritoneal covering of the duct is not to be made until the surgeon feels certain that he is directly over the stone and well above the duodenum, where there are very rarely any vessels in front of the duct. Lower down vessels may be encountered. If any are divided they should be tied at once. The duct with the prominent stone within it projects forwards from its sheath. An ample longitudinal incision is made in the duct so that the stone can be easily

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[1] Padula, *Ann. de Med. Navale,* November 1903.

removed without crumbling. The stone often shoots out or is pressed out by the finger behind the duct. Two mattress sutures may be introduced into the wall of the duct before incising it. These serve to close the incision afterwards, and also act as guides.[1] The escape of bile, which is very profuse, and often infective, if it has been long pent up or if the blocked duct is dilated, must be met by assiduous sponging and previous packing of the kidney pouch of peritoneum.

After removal of the main stone the ducts must be thoroughly and systematically explored, for, as has already been pointed out, there are several stones often present, and the failure to remove them all will render the operation useless. In late cases of obstruction of the common duct, stones may have formed in the hepatic ducts, and may be overlooked and give rise to recurrence of symptoms. This exploration should be carried out with the finger if the ducts are sufficiently dilated, or failing this by a bent probe or small scoop. The finger, however, should be employed wherever possible, because it is the most certain. It is passed both up and down. By conjoint work from within and without the duct a stone impacted low down may be dislodged and removed. Mayo Robson strongly emphasises this point, and mentions a case in which a probe and scoop failed to discover a stone which was found afterwards on digital examination. The probe should be passed into the duodenum to make certain that the papilla is patent. It is often wise to clear out debris by means of a gauze strip passed into the duct.

Drainage. The ducts having been cleared, it remains to consider the different means of treating the opening in the duct. When the gall-bladder has been opened and the cystic duct is freely open, a tube inserted in the gall-bladder and a large tube in the kidney pouch may provide enough drainage, and the opening in the common duct can be closed with a continuous catgut suture. With a free incision, arching of the back and tilting of the liver, the sewing is usually easy, but in very stout women it may be very difficult, and time should not be wasted upon vain attempts to do what is not at all essential provided the kidney pouch and the duct are drained.

In most cases, it is not advisable to close the incision in the common bile-duct, especially if there is septic cholangitis, and if the gall-bladder is not available for drainage. A tube may be tied in the root of the cystic duct when the gall-bladder has been removed. Many surgeons prefer not to close the duct completely, as a rule, because of the safety and the beneficial effects of drainage, and the risk of narrowing of the passage by suturing. Moreover, blood clot may occasionally obstruct a sutured duct.

It will be safer always to drain in some form or other [2] whenever the ducts have been incised. A rubber tube is passed into the common duct and upwards towards the hepatic duct, and secured in position by means of a catgut suture, which pierces the side of the tube and the edges of the wound in the duct (*see* Fig. 224). The part of the tube within the duct has one or more side openings in it. One or more catgut sutures may be inserted if necessary to make the tube fit snugly into the duct. To prevent

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[1] Mayo.

[2] It has been stated that drainage is not needed, as pure bile does not excite peritonitis. I am of opinion that the surgeon can rarely tell for certain whether the bile is pure or not. Certainly in cases where there have been repeated attacks of cholelithiasis with pyrexia it is extremely probable that the bile is infected from the intestines, *e.g.* with the bacillus coli communis. And this is the more likely when any part of the ducts has been long dilated into a large sac.

contamination of the peritoneum, a rubber tube containing a gauze wick which projects at both ends, is passed into the kidney pouch below and outside the wound in the common bile-duct. In some cases drainage may be established through a stab wound into the loin. Mr. Rutherford Morison, of Newcastle, has drawn attention to the importance of draining the kidney pouch.[1] He shows that in the right hypochondrium,
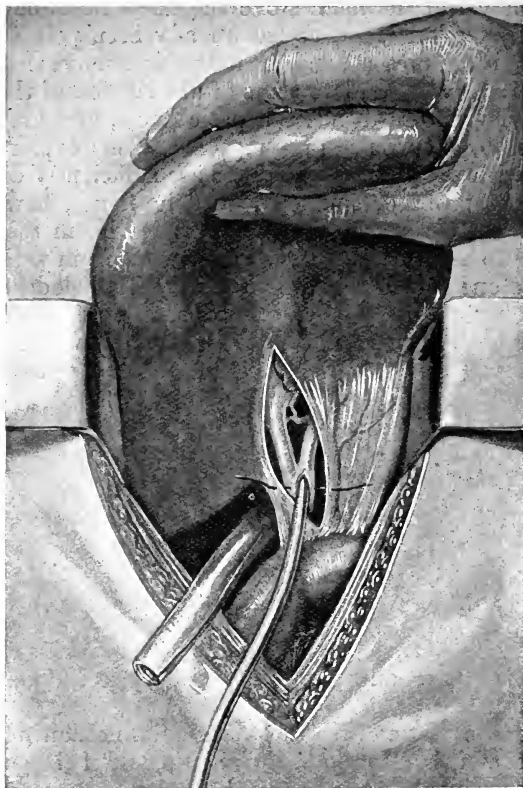
FIG. 224. Choledochotomy. A small rubber tube sewn into the common duct with a catgut suture. This drains into a bottle by the patient's side. A folded piece of soft sheeting is placed in Morison's Pouch, both drains are brought out at the upper and inner angle of the wound.

between the liver and the colon, is a natural space with barriers which separate it, more or less completely, from the general sac. Bile may be allowed to escape into this space as long as it is efficiently drained by an incision made through the posterior parietes immediately below the lower end of the right kidney. If the curved incision which Mr. Morison and others recommend be made use of, the drainage-tube will be in the lower and outer angle of the wound.

If the method which has been described above be followed it will be rarely necessary to drain directly through the loin, and this additional wound can be safely dispensed with except when suppuration exists.

The bile is conducted into a basin at the side of the bed, or better into a bottle by the side of the patient and secured in proper position by tapes.

[1] *Brit. Med. Journ.*, vol. ii, 1894, p. 968.

In all cases it is wise to fix the tube to the skin, so that it may not be accidentally withdrawn.

The tube will become detached in about a week, and may be removed. The larger tube draining the kidney pouch may be gradually withdrawn from the fifth to the eighth day, but never earlier, as its premature removal may cause pain or troublesome bleeding.

Where the duct has been closed with sutures it will still be wise to use a drainage-tube for three days, the indication for this being clearer in cases where the suturing has been attended with difficulty, where the edges of the duct are much bruised, and where any contraction may exist in the biliary passage below.

Rotation of the Duct. I have often used this method of Moynihan with great advantage. When the gall-bladder is shrivelled, empty and embedded in adhesions, and the patient too ill for a prolonged operation, the adhesions need not be separated, but with the left hand passed to the left in front of the lesser omentum and flexed, the common duct with the stone within it as a guide is pushed forwards and to the right into view below the adhesions. A suture is passed into the duct wall, and an incision is made over the stone in the usual way. Much time and trouble may be saved by this manœuvre.

(2) **Stones impacted in the Second Part of the Common Bile-duct** behind the duodenum and the head of the pancreas [1] or within the latter.

If possible the stone should be pushed upwards into the first part of the duct, whence it can be more safely and more easily removed. Failing this, the duodenum may be mobilised by incising the parietal peritoneum about an inch to the right of the descending part, and turning the latter forwards and inwards. Then the calculus is sought, and if found it serves as the best guide to the duct, which may be embedded in the head of the pancreas. When the stone has been found it may be possible to push it back into and remove it from the supra-duodenal part of the duct as adopted by Lane.[2] If this is not possible the duct must be incised, and the calculus removed, and drainage always established. Berg [3] recommends this method in preference to duodeno-choledochotomy.

The objections to this route are that it is difficult and may be accompanied by troublesome hæmorrhage from the pancreas, but usually the pancreatic tissue around the duct is fibrous from chronic inflammation, and does not bleed much. Bleeding is best controlled by suture.

In such cases it is easier and safer to adopt the trans-duodenal route, as Kocher did in one case, on account of severe hæmorrhage from the pancreas, which made him give up the retro-duodenal route.

(3) **Stones impacted in the Ampulla of Vater. Duodeno-choledochotomy** (*see* Fig. 225). Dr. McBurney was the first to perform this operation in 1891. He lays stress upon the following procedure :

" In all cases which are not complicated by very deep adhesions, involving the common duct and descending portion of the duodenum, it is easy and very desirable after determining the presence of a calculus in the lower part of the duct to pass the left forefinger through the foramen of Winslow to a point behind the calculus. With the finger, the lower end of the common duct, the calculus, and the descending portion of the

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[1] A stone impacted in the duct, low down, may give a hard or nodular feel which may suggest malignant disease of the head of the pancreas ; an exploring needle will clear up the case.

[2] *Clin. Soc. Trans.*, 1894, p. 149.   [3] *Zeut. f. Chir.*, 1903, No. 27.

duodenum, can be lifted forward so as to bring these parts nearly or quite to the level of the abdominal incision.[1] The duodenum is then incised in its anterior wall for from an inch to an inch and a half, the orifice of the duct (which is usually markedly altered as to the colour, &c.) is easily found and enlarged with knife or scissors or forceps, and the stone removed. All of this, and even suture of the intestinal wound, should be completed without removing for a moment the left forefinger from its supporting position." [2]
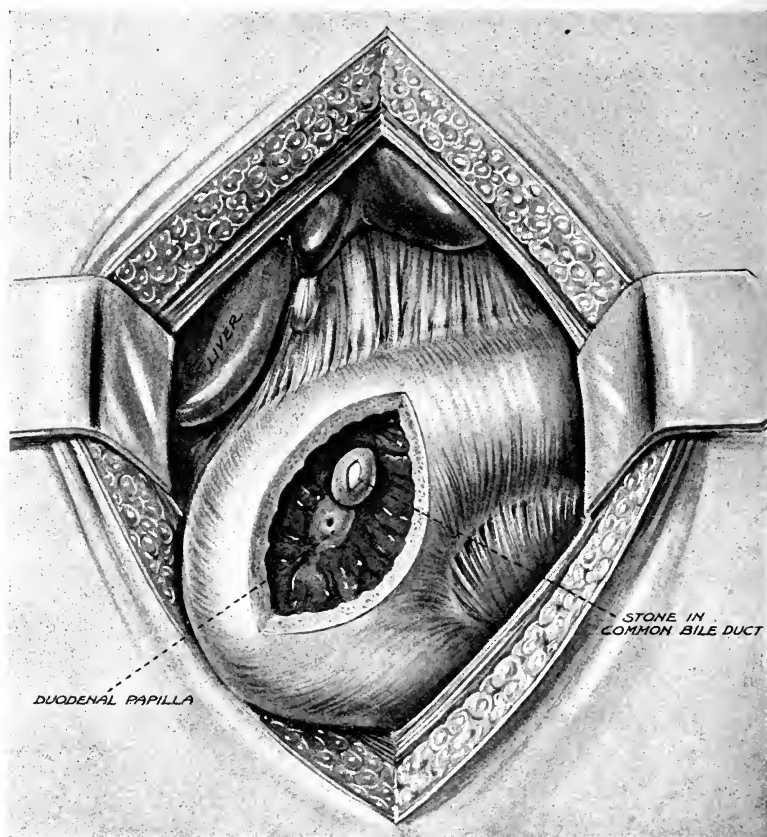
Fig. 225. Duodeno-choledochotomy. The second part of the duodenum is brought into the wound and packed off. A clamp secures the pylorus and common bile-duct. Vertical incisions are made in the anterior wall of the duodenum and end of the bile-duct. The wound in the former is shown too large for the sake of clearness.

When an incision is made through the posterior wall of the duodenum into the common bile-duct before it becomes intramural, as in Kocher's case, extravasation of bile may occur into the retro-peritoneal tissues, unless the incision in the duct is accurately sewn, as advised by Kocher, when the papilla is patent ; if any obstruction exist at the orifice, the edges of the incision into the bile-duct should be sutured to those of the

[1] If the duodenum is not mobile enough, the peritoneum to the right of it may be incised to the required degree.

[2] Dr. Hancock, *Ann. of Surg.*, vol. xl, p. 72.

wound in the posterior wall of the duodenum, thus establishing a fistula between the gall-duct and the duodenum.

If an incision has been already made into the common bile-duct in its first part, a piece of gauze may be drawn downwards from it to the duodenum, thus removing any debris ; [1] but if free drainage is established into the duodenum, it is not necessary to make a separate incision for drainage of the common bile-duct. A scoop must be passed upwards along the bile-duct to prove the absence of stones higher up before the duodenal incision is closed in the usual way with two continuous sutures of fine linen thread, the wound being drawn transversely to the axis of the bowel before it is closed. A piece of the transverse meso-colon is then tacked over the suture line to reinforce it.

The disadvantages of the operation are :

(1) It is difficult ; but when a stone is impacted near it, the biliary papilla is easy to find.

(2) In two of the sixty-two cases collected by Hancock, a duodenal fistula formed, and in one of these it led to the death of the patient from exhaustion ; in the other the leakage spontaneously ceased. With careful suturing a duodenal fistula should be avoidable.

(3) It has a higher mortality than choledochotomy. Infection of the peritoneum from the duodenal opening should be avoidable by careful preparation of the patient and skilful operating.

The advantages which have been claimed are that :

(1) Drainage through the cutaneous wound is unnecessary.

(2) It is easier to sew up an intestinal wound than one in the bile-duct.

(3) The intestinal wound heals more quickly and satisfactorily.

(4) The trans-duodenal route gives an easy and natural access to the common bile-duct in its lower part.

(5) The biliary papilla may be enlarged if stenosed.

(6) A new growth or pancreatic stone in the ampulla may be discovered to be the cause of symptoms, and may be removed.

This method being more severe and dangerous than opening the bile-duct above the duodenum is, of course, only suitable for cases in which it is found to be impossible to remove the obstruction in the usual way.

Dr. Hancock [2] has collected the records of sixty-two trans-duodenal operations ; fifty-seven of these were for the removal of gall-stones, three for pancreatic calculi, and in two new growths of the papilla were found. The mortality of the sixty-two operations was 12·6 per cent., and that of the fifty-seven undertaken for gall-stones was 8·77 per cent. The death-rate from this operation will probably be always higher than that of choledochotomy, because the cases demanding it are often later, and the operation in itself is more severe.

I have had three cases in which this operation was absolutely necessary. Two did very well, but the third, a stout man who had been jaundiced over three months, died of hæmorrhage before the days of serum injection. The following is an account of one of my other cases.

A very stout man, aged 58, with chronic bronchitis, with a history of biliary colic for years. During the last three months he had been rarely quite free from pain and jaundice for more than a few days. While in the hospital he had a shivering fit. He was explored through the usual vertical incision curved inwards at its upper end, and dividing some of the fibres of the rectus muscle. After packing the kidney

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[1] Mayo and Kehr.   [2] *Loc. supra cit.*

pouch and protecting the stomach and intestines with a large flat pad, a stone was felt at the duodenal papilla. In spite of all efforts to press it back into the first part of the duct, it remained firmly impacted. The peritoneum to the right of the duodenum was incised so that the bowel was liberated sufficiently to allow it to be brought well into view. An intestinal clamp was applied across the first part of the duodenum and the common bile-duct behind it. The stone was grasped between the finger and thumb, and pushed well up against the anterior wall of the duodenum, which was incised in a vertical direction directly over the stone, and just above the attachment of the meso-colon. The stone, impacted in the posterior wall of the duodenum, was pressed through the aperture thus made, and seen firmly fixed in the ampulla of Vater, a little of it being visible at the papilla. The mucous membrane covering it was incised upwards along the duct from the orifice, and the stone was easily removed. Then the wound in the anterior wall of the duodenum was closed by a through and through suture of silk, care being taken to place the knots inside the bowel, and, reinforced by a sero-muscular suture of finer silk, a tag of the meso-colon was also sewn over the incision. The suture line was transverse to the axis of the bowel to avoid narrowing the channel. Then the clamp was removed, allowing the gall-bladder, which had been distended, to empty itself into the duodenum. It was then opened, but no stones were found in it, or in the cystic duct. A tube was sewn into the inverted edges of the wound in the gall-bladder, and a large tube containing a wick of gauze was used to drain the kidney pouch, care being taken to place the tube well away from the sutures in the duodenum. The wound was then closed. The patient was kept on water for two days and then the diet was gradually increased. In spite of bronchitis he made a good recovery. Three years later he came to show himself at Out-Patients and was quite well in every way.

CHOLEDOCHOSTOMY

On many occasions a greatly dilated common bile-duct has been mistaken for the gall-bladder and drained, the exact anatomy only being revealed by a subsequent operation for closing the biliary fistula or at an autopsy. The mistake shows the great importance of examining the whole biliary apparatus very carefully before deciding upon the exact nature of the operation, but extensive adhesions, a shrunken gall-bladder, the enormous size of the dilated duct or the gravity of the patient's condition may make the mistake unavoidable. Choledochostomy is not a good operation except as a temporary means when it is not justifiable to do more than is absolutely necessary to save life. As a rule the obstruction of the common duct, such as a stone, should be removed, and if this is clearly impracticable either at once or later, owing to the nature of the obstruction, choledochenterostomy should be chosen as it saves the patient from a troublesome biliary fistula and the danger of a severe and difficult secondary operation. Moreover, it is easier to perform the anastomosis while the duct is dilated. The technique of the operation is just the same as that described under Cholecystostomy.

CHOLEDOCHENTEROSTOMY

Either a (1) lateral or (2) an end to side anastomosis may be made between one of the bile-ducts and the intestine. Of these the first is by far the commonest.

(1) **Lateral Anastomosis.** For an irremovable obstruction in the common duct this is the best operation. Riedel, Sprengel, Swaine and others have recorded instances. In several cases the dilated common duct has been mistaken for the gall-bladder. The technique of the operation is much the same as that described under Cholecystenterostomy except that the duodenum is usually adherent and generally needs mobilising.

It is easier to perform the operation while the common duct is dilated. Years ago I had to perform the operation for the relief of a complete biliary fistula of six months duration. The patient, a young soldier who had not been jaundiced during that period, was bleeding from the gums, and with considerable difficulty the anastomosis was made. The patient died from hæmorrhage into the retroperitoneal tissues and right pleura. The cause of the obstruction was a calcified cyst in the head of the pancreas, by which the common duct was stretched and obliterated.
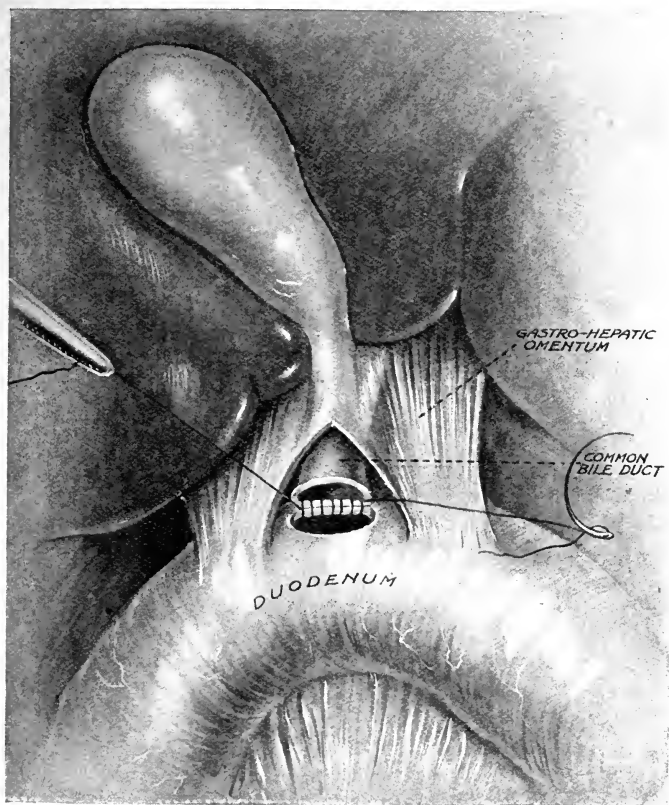
Fig. 226. Choledochenterostomy (modified from Mayo). Two continuous sutures of fine linen thread are used. The buttonhole suture is valuable here to prevent puckering of the narrow stoma.

(2) **End-to-Side Anastomosis.** Mayo [1] describes and figures an end-to-side anastomosis between a dilated hepatic duct and the duodenum. The stricture had formed at the junction of the hepatic and common bile-ducts as the result of cholecystectomy and choledochotomy. The common duct was almost obliterated ; therefore Mayo joined the end of the dilated hepatic duct to the mobilised duodenum. He first approximated the connective tissues around the duct to the duodenum by sutures, and then joined the duct and the opening of the duodenum by a double row of sutures. The patient did very well.

[1] *Ann. of Surg.*, 1905, vol. ii, p. 90.

CHOLEDOCHECTOMY

Doyen removed a portion of the common bile-duct which had been torn across during the removal of a stone. He pared the frayed edges and joined them together over a rubber tube inserted in the duct. I should not like to leave the tube within the duct, especially if its end did not project into the duodenum. Kehr resected a simple stricture of the duct and joined the latter by suture except for an opening in front, into which a tube was inserted for drainage. Moynihan performed a similar operation for a malignant stricture, but the patient died of recurrence in the portal fissure within three months.

Mr. Upcott [1] records two cases of carcinoma of the ampulla of Vater and reviews the literature. He found 16 recorded resections of the tumour including his own case. In 13 the transduodenal route was adopted with 8 recoveries, and in 3 a segment of the duodenum was removed with 2 recoveries. The following is quoted from Upcott's own account of his operation :

" Nothing was felt in supraduodenal part of common duct, but at the lower end of the common duct in the posterior wall of the duodenum was felt an oval mass the size of a large olive. This was movable, but could not be pushed up above the duodenum, it had a clearly defined outline and was of firm consistency, but did not feel as hard as a stone.

" The duodenum was mobilised and its anterior wall incised transversly over the mass, which was then readily projected through the anterior incision. It appeared as an oval projection with its long axis coinciding with that of the duodenum and covered with the mucous membrane of the posterior wall. On its most prominent part was the stretched opening of the ampulla. It was readily lifted away from the tissues posteriorly. A small cut was made into the mass, exposing a pale, bile-stained tumour substance (see Fig. 227).

" The mucous membrane was incised around the tumour, which was then drawn forward and cut away. A quantity of turbid mucus escaped from the divided end of the common duct. A small, oval, unfaceted stone was removed from the upper end of the common duct. The cut edges of the dilated bile-duct were sutured to the margins of the mucous membrane. The cut end of the pancreatic duct could not be identified in the wound, so the lower part of the incision was not sutured. The anterior incision in the duodenum was closed by suture. Further palpation of the common duct showed a palpable lymph-node a little way above the duodenum and a firm mass of several nodes in the gastrohepatic omentum just to the left of the hepaticocystic confluence. The gall-bladder was drained and the abdomen closed. The patient, aged 65 made a good recovery and rapidly gained weight."

The tumour is generally a slow-growing columnar-celled adeno-carcinoma. It causes obstruction quite early and usually causes death in this way before the lymphatic glands in the portal fissure become infected, or dissemination occurs. An exact diagnosis is very rare until the abdomen is opened, and even then the tumour may be mistaken for stone. Cholecystenterostomy may prolong a patient's life for a long time up to two years, but a radical operation should be attempted whenever possible. This may be done in one or two stages, palliative drainage being done at

first.   The commonest method of resection has been well described by Mr. Upcott (*vide supra*).   The alternative method is by " circular resection of the duodenum followed either by axial anastomosis or by closure of the cut ends and gastro-enterostomy.   The passage of the bile may be provided for by implantation of the common duct into the bowel or by cystenterostomy."   Mr. Upcott believes " that the simpler operation of

GROWTH AT
DUODENAL PAPILLA
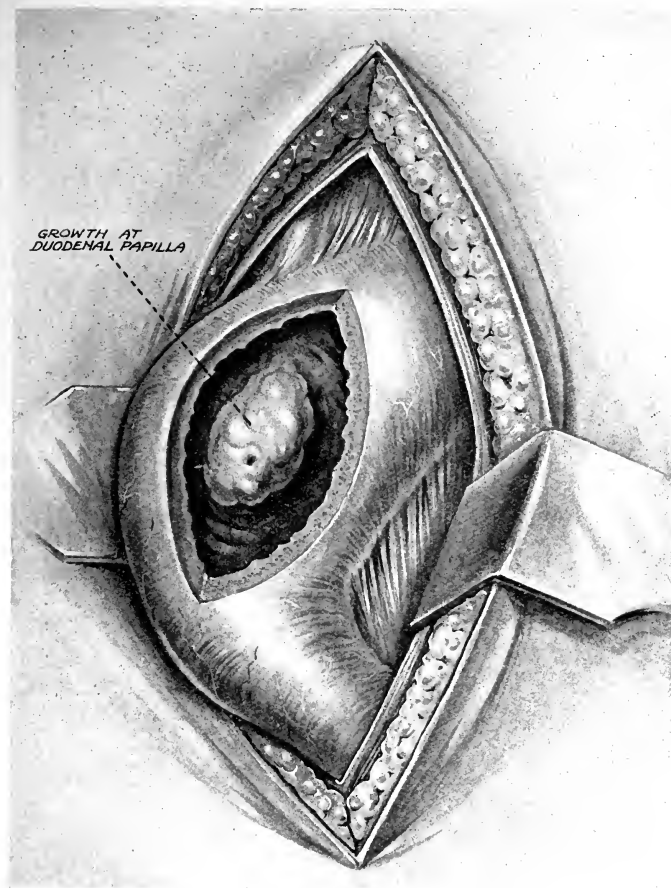
FIG. 227.   Choledochectomy.   A growth is shown at the duodenal papilla.

transduodenal excision will prove the best for most cases of cancer of the ampulla.   If the growth is too extensive to be removed in this way a palliative operation will be preferable to the formidable resection advocated by Kausch." [1]

PLASTIC OPERATIONS ON THE BILE-DUCTS

For some cases of simple stricture a plastic operation may be satisfactorily performed.   A longitudinal incision through the stricture extending into the ducts above and below may be sewn in the transverse direction

[1] *Zent. f. Chir.*, 1909, vol. xxxvi, p. 1352.

as in pyloroplasty or Finney's operation. Moynihan describes a very successful case. Similar plastic operations have been very successfully carried out for stricture of the ureter.

The Mortality of operations upon the Gall-bladder and Bile-ducts. This has been greatly diminished during recent years, especially in the hands of surgeons with a large experience of these operations. It must not be forgotten, however, that the average operator does not get nearly such good results as those mentioned below. Dr. Mayo [1] and his brother had 66 deaths in 1500 operations upon these organs. In the last 500 cases the death rate was only 3·2 per cent. These statistics include all operations for acute perforations, with septic peritonitis and malignant disease ; and also all deaths occurring in the hospital without regard to the length of time after the operation. " There were 845 cholecystostomies with a mortality of 2·13 per cent." In the last 272, the death-rate was only 1·47. There were 319 cholecystectomies, with a death-rate of 3·13 per cent., which was reduced to 1·62 per cent. in the cases included in the last 500 operations.

There were 207 operations upon the common duct. Dr. Mayo divides them into four groups :

Group 1. In one hundred and five, gall-stones were present in the common duct, but without any serious symptoms of infection or complete obstruction. The mortality was 2·9 per cent.

Group 2. There were 61 cases, in which infection of the common and hepatic ducts had occurred, with " remittent fever " and deep jaundice (infective cholangitis). Ten deaths occurred giving a mortality of 16 per cent., and in seven cases hepatic duct stones had formed and gave rise to later troubles.

Recurrence of stones also occurred in at least three cases in which there was enlargement of the head of the pancreas.

Group 3. There were 29 cases with complete obstruction of the common bile-duct, with 10 deaths (34 per cent.). The general condition of these patients was very bad, and some of them had œdema of the feet, with bile-stained fluid in the peritonæal cavity, nephritis, and more or less cholæmia. Dr. Mayo believes that " it is often wise to wait for a period of remission before operation " in cases of acute complete obstruction.

Group 4. There were 12 operations for malignant disease with 4 deaths, $33\frac{1}{3}$ per cent.

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[1] *Loc. supra cit.*

CHAPTER XXVIII

CHOLECYSTENTEROSTOMY AND OPERATIONS FOR BILIARY FISTULA

In this operation a communication is made between the gall-bladder and the small or large intestine. Whenever feasible the duodenum or upper jejunum should be preferred. The duodenum is the best but must be mobilised if necessary to bring it well forward, otherwise the operation may be very difficult. When the jejunum is chosen, kinking of the jejunal loop may occur as after anterior gastro-jejunostomy, unless the bowel is sewn to the liver above and to the left of the anastomosis. When the upper part of the small intestine is too matted by adhesions to come up sufficiently, the stomach or failing this the hepatic flexure of the colon should be chosen. Mayo joined the gall-bladder to the transverse colon in five cases in which he was unable to use the duodenum, and the results were excellent; but the value of the bile for digestion and absorption is lost. The chief indications for the operation are:

(1) Irremediable obstruction of the common duct, due to calculus, cicatricial contraction or growth of the duct. The operation should be rarely required for calculous obstruction, for it is much better to remove the obstruction if possible. In some cases this may not be practicable, or the condition of the patient may make the attempt inadvisable. Leaving the stones may lead to suppurative cholangitis or to the development of malignant disease.

(2) In irremovable obstruction of the cystic duct with mucocele or mucous fistula, where cholecystectomy is impracticable.

(3) A persistent fistulous opening after operation on the gall-bladder, or due to stricture, or occlusion of the common duct, giving rise to a constant escape of bile, causing persistent excoriation and annoyance owing to eczematous rawness. In such cases the operation of cholecystenterostomy was recommended thirty years ago in this country by Mr. Willett.[1]

(4) Chronic pancreatitis.

(5) Malignant disease about the head of the pancreas, occluding the common duct and giving rise to jaundice, itching, &c. Irremovable growth of the common duct or ampulla of Vater may be added. In such cases cholecystenterostomy must involve increased risk. Hæmorrhage and imperfect repair are the chief dangers, the first especially so, but with early operation these dangers are not so great.

(6) Injuries, especially division, of the common bile-duct, when the channel cannot be restored.

Cholecystenterostomy may not be practicable with a contracted gall-

¹ *Brit. Med. Journ.*, 1886, vol. ii, p. 903.

bladder, and it may be very difficult or impossible to bring any part of the intestine up without kinking when adhesions are dense and diffuse. In such cases the gall-bladder may be joined to the anterior surface of the stomach without any ill effect from the discharge of bile into the stomach. Perrier [1] collected seven recorded cases of cholecystgastrostomy, with six recoveries. The writer had one very successful case.

Operations. In all my operations—fifteen in all—I have used the suture method. The button is not nearly so good in my opinion. Packs are carefully placed, and a lumbar cushion is used. The gall-bladder is first emptied by aspiration and then joined to the intestine
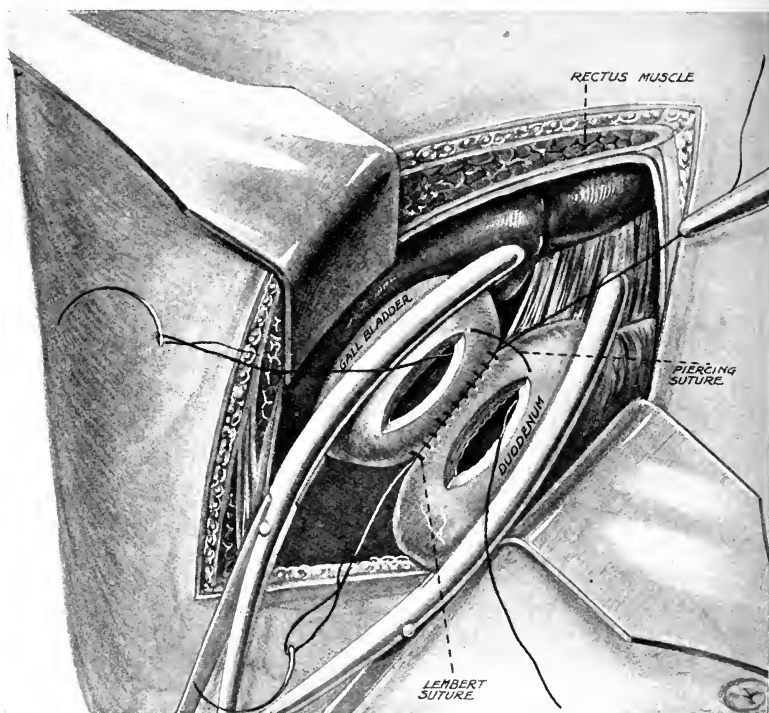
Fig. 228. Cholecystenterostomy. Two continuous sutures of fine linen thread are used. Here the duodenum is engaged in the anastomosis.

with the aid of curved clamp forceps and two continuous sutures, as in the operation of gastro-jejunostomy (p. 160) (*see* Fig. 228). The aperture should be made at least an inch long. Fine linen thread is the best material for both sutures. The deep suture is soon cast off into the bowel so that there is no fear of its serving as a nucleus for stone formation. The clamps are removed as soon as the deep suture is completed—the intestinal one first—for this makes it easier to complete the serous suture, especially when the gall-bladder is small, adherent or deeply placed.

Objections to the Operation. For suitable cases it is a splendid operation, but (1) it has often been adopted when the cause of obstruction should have been removed and a cure obtained instead of relief granted.

[1] Quoted by Moynihan.

(2) Another objection, though, I believe, only proved by a few cases as yet, is that of septic infection of the ducts and liver from the intestine. We must remember how very different are the conditions after cholecystenterostomy, to those in health, as regards a communication between the intestine and the biliary passages. That a patient after this operation, as long as the opening remains free, must be menaced with the danger of septic infection is proved by a case reported by Rickard.[1] Here death occurred fifty-three days after cholecystenterostomy, although the patient did well at first.   The necropsy showed that death was due to infection of the biliary passages from the intestine, numerous abscesses due to ascending infection being present. (3) There is the risk of contraction of the stoma.

(4) After this operation the bile is diverted through the cystic duct and gall-bladder into the bowel. The gall-bladder takes on itself the function of the common duct, and the common duct, remaining patulous at its upper end, receives a certain amount of bile which stagnates under conditions which favour its crystallisation, especially if, as is often the case, the common duct already contains stones.

It seems to me to be quite unnecessary to exclude the part of the intestine which is joined to the gall-bladder, with the object of preventing the intestinal contents from reaching the gall-bladder. Moynihan in one case adopted this plan, using what is practically an adaptation of Roux's method of gastro-jejunostomy. Mikulicz suggested anastomosing the limbs of the loop of intestine which is joined to the gall-bladder. Not only are these complications superfluous, but they are both impracticable except when the jejunum is used, which is not always the best part to choose.

TREATMENT OF BILIARY FISTULA

Biliary fistulæ may be either (a) external or (b) internal.

(a) **External or Cutaneous Biliary Fistula** is generally due to some obstruction to the biliary passages by impacted stone, stricture, valve formation either congenital or post-operative, innocent or malignant growths of the bile duct or pressing upon it. Sometimes a fistula is due to an error of technique during an operation ; for instance, a short gall-bladder fixed to the parietal wound may by traction kink the junction of the hepatic and common duct, with the result that all the bile is diverted through the gall-bladder to the surface.

Biliary fistulæ are much rarer than they were some years ago, when stones were more commonly left in the common duct. The same is true of mucous fistulæ due to stone or other obstructions of the cystic duct.

Operation. Sometimes syringing through the fistula may dislodge a stone and cure the fistula, but as a rule the abdomen has to be opened below and internal to the fistula and the biliary apparatus thoroughly explored. Any obstruction found is removed if possible. Failing this the gall-bladder is detached from the parietes and anastomosed to the duodenum, stomach or jejunum, or in some cases to the colon. In some cases of kinking following operation it is best to remove the gall-bladder after proving the way clear by passing a probe along the common duct to the duodenum. When a mucous fistula persists, cholecystectomy is

[1] *Bull. Soc. Chir.*, t. xx, 1894, p. 572.

indicated, or failing this, the mucosa may be shelled out from a mass of adhesions, or a stone in the cystic duct may be removed.

(b) **Internal Biliary Fistulæ** may form between the gall-bladder or bile-ducts and any neighbouring or even distant hollow viscus when the gall-bladder is either abnormally placed or greatly dilated. Nearly always fistulæ are the results of inflammation with adhesions and ulceration due to gall-stones, although occasionally they may be due to malignant disease or operation.

The commonest internal fistulæ are between the gall-bladder or common bile-duct and the duodenum, stomach or colon. Often they do not call for interference for they either heal spontaneously after the stone has passed, or they cause no serious harm. For instance, an old lady had a fistula between the gall-bladder and the colon discharging most of the bile unaltered by the anus, sometimes without any admixture of fæces. After three months the fistula closed spontaneously. The stone which probably caused the fistula was never noticed in the fæces.

When a fistula is discovered during an operation, and if it interfere with a satisfactory examination or treatment of the biliary apparatus, the adherent viscera should be detached, the edges pared and each opening closed with two continuous sutures in the usual way; but before doing this it must be clear that the bile can reach the bowel through the natural passage.

CHAPTER XXIX

OPERATIONS ON THE PANCREAS

THE TREATMENT OF INJURIES, PANCREATITIS, PANCREATIC CALCULI, PANCREATIC CYSTS, AND NEW GROWTHS

FOR a knowledge of these diseases we are largely indebted to Senn, Fitz, Opie, Mikulicz,[1] and Mayo Robson.[2] The last two especially have done brilliant work in establishing the diagnosis and treatment of diseases of the pancreas upon a sound basis. Placed deeply in the abdomen, and surrounded by structures of great importance, this organ was long considered to be beyond the reach of surgery, but more accurate knowledge of the pathology of the pancreas, and of the special surgical principles which must be observed to attain success in this branch of surgery, has already done much to change our views, and recent results show that the future is full of promise.

We owe much to Professor Mikulicz for pointing out the best ways of dealing with the peculiar dangers and difficulties which attend operations upon the pancreas.

Difficulties and Dangers and the Methods of meeting them. (a) *Diagnosis.* The position of the pancreas makes it very difficult for us to feel and recognise any enlargement of it, unless the patient is very thin or the abdominal wall relaxed under the influence of an anæsthetic.

The function of the organ is not influenced very much until the disease is too advanced or extensive for successful surgical treatment to be undertaken. Systematic examinations of the urine [3] and of the fæces will very probably provide us with earlier indications of functional changes, and will enable us to arrive at a diagnosis or to explore earlier than heretofore. Until recently wounds and contusions of the pancreas were more serious than those of any other abdominal organ. The chief reasons for the high mortality were (a) the low condition of the patient at the time of the operation, owing to delay in diagnosis ; (b) hæmorrhage and the difficulty of arresting it ; (c) escape of pancreatic secretion into the peritoneum ; (d) concomitant injuries.

(b) *Hœmorrhage.* The pancreas is friable, and its vessels thin-walled and very numerous, so that it is very difficult to stop bleeding from it. It is impossible to catch the individual blood-vessels with artery forceps in the usual way, and ligatures often do not hold, but tear through the delicate tissues and blood-vessels. It is best to suture any wounds or lacerations with stout catgut, which must take a good bite, and must not pierce the ducts or be drawn too tightly. Ligaturing

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[1] *Ann. of Surg.*, 1903, vol. xxxviii, p. 1.
[2] Hunterian Lectures, *Lancet*, 1904, vol. i, pp. 773, 845, and 911.
[3] Cammidge, *Lancet*, 1904, vol. i, p. 782.

en masse will also stop the bleeding, but gangrene of the isolated tissues may arise and be followed by secondary hæmorrhage. Gauze packing is usually successful. Hæmorrhage is not only serious in itself, but the blood also forms with the pancreatic juice an excellent culture medium for bacteria.

(c) *Escape of Pancreatic Juice* and exudation from the injured and inflamed gland into the peritoneal cavity is a very serious catastrophe, which almost inevitably leads to peritonitis, whether the contaminating fluid is originally infective or not. The pancreas is very easily infected from the common bile-duct, which often contains infective material, owing to the obstruction at the ampulla of Vater, which is frequently the cause of the pancreatic disease. Every effort must therefore be made to prevent any leakage of the pancreatic exudate into the peritoneal cavity. This can be done by providing free anterior drainage, or in some cases by suturing the peritoneum over the pancreas, and establishing posterior drainage. It is dangerous to let the fluid escape and burrow in the retro-peritoneal tissues, for infective cellulitis may result. Moreover, the pancreatic juice dissolves the clots in and around the severed blood-vessels, and restarts hæmorrhage. It is essential, therefore, to drain away the fluids from the injured or diseased pancreas, and failure to do this has almost always led to disaster.

The danger of wounding the pancreas during operations is shown by the fact that out of 30 resections of the stomach in which the pancreas was wounded either accidentally or intentionally the mortality was 70 per cent., whereas the death-rate of 91 resections without any injury of the pancreas was 27·5 per cent. The difference could not be entirely or even chiefly due to the more extensive or later disease, for the deaths mostly occurred not from shock, but from peritonitis, which was doubtless due to the escape of pancreatic secretions into the peritoneum (Mikulicz).

Various Methods of approaching the Pancreas. There are several ways of reaching this deeply placed organ, and they may be conveniently divided into anterior and posterior operations.

The anterior route allows a far more thorough exploration, but the posterior provides the best drainage in some cases, and carries less risk of peritoneal infection from escaping pancreatic secretions.

The Anterior Route. The abdomen is opened by making an incision between the umbilicus and the ensiform cartilage, a little to one or other side of the middle line (*see* Fig. 1, p. 2). The fibres of the rectus may be either drawn out or separated. Better drainage is provided by separating the fibres, and this also gives less risk of infection of the abdominal wall in septic cases. Where drainage is likely to be quite unnecessary, a valvular incision may be made by displacing the rectus (*see* p. 3). The abdomen having been opened, there are several ways of exposing the pancreas. In some cases the surgeon has no choice, for a swelling, such as a cyst or abscess, has already approached the surface either below or above the stomach, and the surgeon should then abide by nature's decision. When little or no swelling exists much may depend upon the mobility and position of the stomach.

(a) *Through the gastro-colic ligament* (*see* Fig. 229). This should be picked up and incised below the greater curvature, and the vascular arch that lies beneath it. A vertical incision should be made to avoid

the omental blood-vessels, and this should be enlarged to the required extent by stretching. The lesser sac having been opened, the anterior surface of the pancreas can be examined after displacing the stomach upwards.

(b) *Through the gastro-hepatic omentum* a transverse incision is made through this membrane where it is thin above the vascular arch, and to the left of its thick right border, which includes the portal vein, hepatic artery, and common bile-duct. When the stomach is drawn downward, the pancreas can be explored with ease.

(c) *Through the transverse mesocolon* after displacing the colon upwards as in gastro-jejunostomy. This method does not give such a
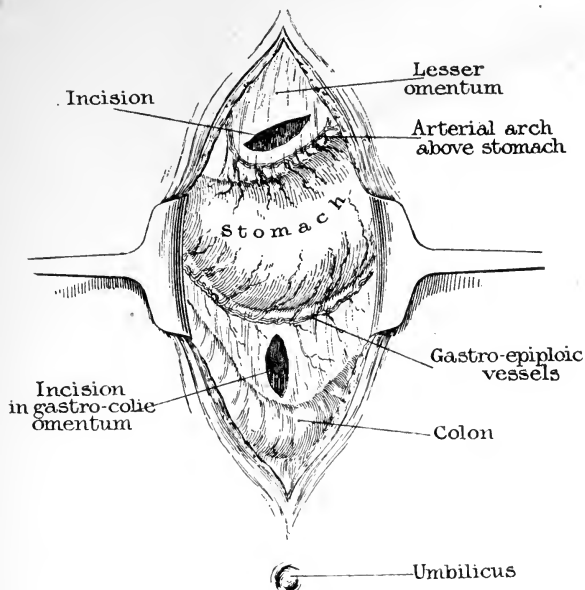
FIG. 229. The pancreas is best approached either through the gastro-colic ligament or through the gastro-hepatic omentum, according to the relation of the stomach to the pancreas and to the position of any bulging.

good view, or so direct an approach, and, lastly, it is unfortunately placed for establishing anterior drainage, for any leaking fluid will at once gravitate amongst the coils of small intestine. Dr. Porter, however, used this route in his successful case of acute pancreatitis; he made a transverse incision within the arterial arch which supplies the transverse colon.

(d) *By displacing the duodenum* after Kocher's method of incising the parietal peritoneum to the right of the descending part of this intestine. This method only gives access to a part of the head, and its adoption is difficult and may be attended with profuse hæmorrhage. Moreover, drainage is difficult from this situation.

(e) *Through the duodenum.* The pancreatic duct towards its termination and the ampulla of Vater may be reached through a longitudinal incision in the anterior wall of the duodenum (*see* Fig. 225, p. 482).

(f) *Through the stomach.* This method is only mentioned to be condemned. Hagen used it successfully in one case, that of a very adherent

pancreatic cyst in a boy. It was found to be impossible to bring the cyst to the abdominal incision, and as it lay directly behind the stomach, the anterior and posterior walls of the latter were incised, and the cyst emptied. A part of the costal margin was then resected, and the cyst wall, now more movable, was brought to the parietal peritoneum after placing the sutured stomach. In such a case it would be far better to first aspirate the cyst below or above the stomach, and then to bring the lax cyst wall to the surface, or, failing this, to fix a tube in it with a purse-string suture. It might also be approached from the left loin.

(g) *The Posterior Route.* Either an oblique or a vertical incision may be made in the left loin, or in some cases of disease of the head of the pancreas in the right loin. The vertical incision should be parallel and a little external to the outer border of the erector spinæ, as advised by Mr. Cathcart. An oblique incision closely resembling the one employed in nephrolithotomy may be used.

INJURIES

The pancreas is not often injured, because of its deep and protected position, but when it is damaged either from contusion or penetration, other organs are very frequently affected at the same time.

When the abdomen is explored under these circumstances, pancreatic lesions are very apt to be overlooked, with fatal consequences. It is important, therefore, to examine this organ before completing all explorations for injuries of the upper abdomen.

Apart from wounds, it will be a rare event for a correct diagnosis to be arrived at before the abdomen is opened for signs of internal hæmorrhage, abdominal tenderness and rigidity indicating peritoneal irritation of uncertain cause, but demanding immediate attention. In a few cases a swelling may appear in the epigastrium, and in one case that I saw there was glycosuria.

Even when an injury of the pancreas is suspected the abdomen should be explored through an incision near the middle line, so that the other viscera may be examined also. Blood may ooze from the lesser sac of peritoneum, or areas of fat necrosis may draw the attention of the surgeon to the pancreas, which he may then find to be enlarged from hæmorrhage.

The gland may be approached either through the gastro-colic ligament, small omentum, or transverse mesocolon.

Hæmorrhage must be arrested by sutures, ligatures, or gauze packing, and free drainage must be established either anteriorly, posteriorly, or both ways. When the peritoneum can be sewn over the damaged organ this should be done, but this does not abolish the need of drainage, at least through the loin.

In cases of wounds from behind, it is only necessary to explore the abdomen when signs and symptoms of penetration of the peritoneum manifest themselves ; but the patient should be carefully watched, so that abdominal section can be undertaken immediately if any indications arise.

Gunshot wounds are generally penetrating, and inflict injuries upon neighbouring organs, such as the stomach, colon, or small intestine. In any case drainage is essential.

Mikulicz collected 45 cases of injury of the pancreas, 21 penetrating

and 24 subcutaneous lesions. Of the former 12 were gunshot wounds, of which 5 were treated by operation, with 3 recoveries ; and 7 were not operated upon, all of these died.

Out of 9 stab wounds only 2 penetrated the peritoneum ; no drainage was employed in one of these, who died ; the other recovered notwithstanding multiple intestinal perforations.

All of the 7 with retro-peritoneal stab wounds recovered, but in several of these the gland had prolapsed into the wound without being seriously damaged.

In some cases the tail may be resected after ligation or suture of the gland near the line of section to prevent hæmorrhage.

Out of 24 subcutaneous injuries no operation was undertaken in 13 ; all of these patients died, but as death was the means of the discovery of the lesions, it is quite possible and even probable that some patients recover from slight subcutaneous injuries. Of 11 treated by operation 7 recovered.

It is significant that out of 12 operations for various injuries drainage was employed in 8, with 6 recoveries, and that the 4 cases in which drainage was not considered necessary ended fatally.

Dreifuss [1] reports a successful operation for rupture of the pancreas and mentions 23 recorded cases with 16 operations and 11 cures, and 7 cases not submitted to operation, all fatal.

Dr. Randall [2] successfully operated on a man, æt. 48, who had been injured in the epigastrium by the pole of a van, which jammed him against a stationary van. The operation was undertaken six hours after the injury, on account of gravity of the collapse, the site of the injury, and dulness in the right flank. The abdomen was opened above the umbilicus, and much clotted and fluid blood was removed. A large tear was found in the small omentum, and another in the posterior wall of the lesser sac, through which a laceration two inches long was discovered in the body of the pancreas, and the aorta was felt in the floor of the wound, which was sutured with four silk stitches. There was not much trouble from hæmorrhage. Drainage was established, and the peritoneal cavity cleansed and irrigated. The man ultimately recovered completely, although he had troublesome mental symptoms for a time and developed a ventral hernia at the site of drainage.

ACUTE PANCREATITIS ; ACUTE HÆMORRHAGIC PANCREATITIS

This is an acute inflammation of the pancreas, usually associated with and sometimes arising from profuse interstitial hæmorrhage, and either terminating fatally in a few days or subsiding into subacute or chronic pancreatitis. In some cases suppuration or even extensive gangrene of the pancreas may occur. In many cases there is a history of gall-stones, and in some, stones are actually found impacted low in the common duct at the time of the operation or upon post-mortem examination.

The first accurate account of this rare disease was given by Fitz.[3] Since then a number of cases have been recorded by various observers.

The chief symptoms, as summarised by Fitz, are : " sudden, severe, often intense epigastric pain, without obvious cause, in most cases followed by nausea, vomiting, sensitiveness, and tympanitic, sometimes dull, swelling of the epigastrium. There is prostration, often extreme, frequent collapse, low fever, and a feeble, slow at first but soon quickening pulse. Obstinate constipation for several days is the rule, but diarrhœa

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[1] *Semaine Med.*, November 18, 1908. [2] *Lancet*, 1905, vol. i, p. 291.
[3] *New York Med. Record*, 1889.

sometimes occurs. If the case does not end fatally in the course of a few days, recovery is possible, or a recurrence of the symptoms in a milder form takes place, and the characteristics of a subacute peritonitis are developed."

Cyanosis of the face with a general lividity is also a striking sign in some cases ; this was evident in several patients that I have seen. The patient often groans loudly and breathes hurriedly. Slight jaundice is sometimes seen, and often there is impaired resonance from effusion in the flanks.

Very few of the cases have been correctly diagnosed, the majority, as will be readily understood by consideration of the above-mentioned symptoms, having been thought to be either acute peritonitis (especially that due to perforation of a gastric ulcer) or acute intestinal obstruction, usually the latter. Recently a correct diagnosis has more frequently been made.

In a few instances the presence of an epigastric tumour has materially aided the diagnosis ; such cases have been recorded by Thayer,[1] Pitt,[2] and others. In Thayer's case, abdominal section revealed the presence of an abscess in connection with the pancreas, drainage of which resulted in recovery. In Dr. Pitt's case, the tumour was chiefly due to blood effusion in and around the pancreas.

Treatment. The uncertainty of the diagnosis, or the fact that acute pancreatitis was suspected, has led, in the majority of cases, to the performance of an exploratory laparotomy. Should such an operation be performed on a patient supposed to be suffering from either acute intestinal obstruction or acute peritonitis with a negative result, the possibility of acute pancreatitis must be considered. The following points will be found useful under such circumstances :

(1) *Fat necrosis* may be present. This occurs in the form of small patches, circular or oval in shape, and of an opaque white or yellow appearance, scattered about the fat over the pancreas, the omentum, and the mesentery. If, on careful inspection with a good light, evidence of fat necrosis is found, it may be inferred that some serious lesion of the pancreas is present. Absence of fat necrosis, on the other hand, does not exclude the possibility of acute pancreatitis.

(2) *Peculiar blood-stained fluid* is found within the abdominal cavity.

(3) *Swelling of the pancreas on palpation.* This may be due to inflammatory exudation, blood effusions, or a collection of pus. In order to further examine the pancreas, it must be approached either through the small or great omentum, whichever is found to be the more convenient. It is then found to be greatly swollen, soft, and of a purplish colour.

If a diagnosis of acute pancreatitis is made either before or after exploratory laparotomy, the further treatment will depend upon the particular condition of the pancreas that is found to be present. Saline axillary infusion is commenced to combat shock.

The swollen gland is incised or, better, punctured with blunt-nosed forceps with due regard to the large blood-vessels and the pancreatic duct. Hæmorrhage is arrested by means of tampons of gauze, and free drainage is established either anteriorly or posteriorly. Mr. Mayo Robson favours posterior drainage through the left loin. The disadvantages of this are that (1) another incision will have to be made, and time is often very important in these cases. With the patient turned over on his right

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[1] *Amer. Journ. of Med. Sci.,* vol. cx.   [2] *Clin. Soc. Trans.,* vol. xxxii.

side, posterior drainage can be rapidly and safely established, after incising the muscles of the left loin by inserting a dressing forceps from behind, with the guiding aid of the left hand, within the abdomen.   Injury of the important vessels can be avoided in this way.   (2) Posterior drainage does not certainly prevent leakage from the anterior surface of the gland into the peritoneal cavity ; on the other hand, it does prevent retro-peritonæal extravasation.   Therefore anterior drainage also is necessary. Posterior drainage is direct and dependent.

Anterior drainage is established, the lesser sac being always drained, either above or below the stomach, and the pelvis also in late cases.   In all cases a gauze roll is passed down into the pelvis to mop up the effusion there, while the pancreas is examined.   The pelvis is drained with a tube inserted through a stab wound above the pubis.

Mr. Mayo Robson recommends that the gall-bladder and bile-ducts be examined, and that if a calculus be discovered at the ampulla it should be removed if the patient's condition allow, or if not, that a cholecystotomy be performed, with the object of providing a vent for the retained and infective contents of the biliary and pancreatic ducts.

Opie and Mayo Robson have shown that regurgitation of septic bile into the pancreas is at least a common cause of acute pancreatitis. But the condition of the patient is rarely such as to allow any radical operation, and it cannot be said that even cholecystotomy is necessary for recovery, although it may contribute towards it, if done without unduly prolonging the operation.

Owing to the extremely serious condition that the patient is usually in, every possible precaution must be taken to avoid shock, and the operation itself must be performed as rapidly as possible.

For a long time acute pancreatitis was regarded as an inevitably fatal disease, so that when it was discovered during an exploration no attempt was made to deal with the pancreas directly.

In four cases, however, peritoneal drainage alone was attended with success.

Dr. Muspratt,[1] an old Guy's man, was the first to treat this disease rationally on Dec. 2, 1902, and his surgical instinct and courage were rewarded by the recovery of the patient.

The patient was a woman, 40 years of age, who, after years of abdominal suffering, was suddenly seized with severe pain in the abdomen, attended by collapse and persistent vomiting.   Laparotomy was performed within twenty-four hours, and a swollen, tense, and purple pancreas discovered.   A free incision was made into its head, and free hæmorrhage followed, but this was checked after some trouble, a gauze drain was inserted, and the patient rapidly recovered.

Dr. Porter, of Boston, soon afterwards operated successfully upon the same lines, on Feb. 17, 1903.[2]   The patient was a man, 56 years of age, who was under treatment in October 1902 for dull pain in the right hypochondrium, from which he had suffered for several years.   He also complained of chronic constipation.   A year before admission he had sharp pain in the epigastrium and right iliac fossa.   He had never had jaundice, vomiting, or rigors.   From Nov. 5, 1902, to Feb. 17, 1903, he had several attacks of severe pain in the right hypochondrium and epigastrium, and in January 1903 slight jaundice appeared, and gall-stones were diagnosed.   On Feb. 15 sudden, severe epigastric pain developed, and extended to the right iliac fossa.   The pain continued in spite of temporary relief with morphia, and later it became general all over the abdomen, and it was accompanied with vomiting and constipation which was not complete.   The man was emaciated, very restless from much pain and distress ; the vomit was neither fæcal, nor did it contain blood.

[1] Dr. Muspratt and Dr. Ramsay, *Brit. Med. Journ.*, 1904, vol. i, p. 304.
[2] Mikulicz, *loc. supra cit.*

Abdominal distension and rigidity was moderate, and there was no visible peristalsis. Shifting dulness was noticed. The temperature was 100°, the pulse 100 and weak, the respiration 30 per minute. A diagnosis of intestinal obstruction due to a band was made : the band being considered to be secondary to gall-bladder or appendicular disease. An incision was made from 3 inches below the ensiform cartilage to within 2 inches of the pubis. A large amount of brownish red fluid escaped ; this proved to be sterile.[1] No obstruction could be discovered, the appendix was congested and was removed, the fat in its mesentery was necrosed. The gall-bladder was full of bile, the pancreas was twice the normal size, hard and tense. The abdomen was irrigated and the wound closed. A second incision was now made parallel to the left costal margin, which was retracted, and the stomach and small intestines were packed away with gauze, and the pancreas approached through the transverse meso-colon ; it was very large, tense, œdematous, and deep purple in colour. No stones could be felt in the pancreatic duct. The pancreas was freely incised along its an-terior surface, and drainage was established. The patient improved rapidly. In April it was considered to be necessary to re-operate on account of recurrence of pain. A small cavity was found in the pancreas containing sterile debris. The gall-bladder was stitched to the wound, but not opened. The duodenum was turned forwards for examination of the head and duct of the pancreas. Pneumonia followed, but the patient recovered in spite of this and gained ten pounds in weight. Interesting cases are recorded by Judd,[2] Ransohoff,[3] and Deaver.[4]

Prognosis. Without operation the chances of recovery are very small, but with *early* operation there is a fair prospect of recovery. Korte [5] found that of 21 cases operated upon before the stage of necrosis 16 recovered, whereas out of 13 cases with necrosis of the pancreas only 2 recovered.

Mikulicz analysed the records of 75 cases of operations for acute pancreatitis, of 37 of these in which the pancreas itself was involved in the operative interference, 25 recovered. Of 41 where the pancreas was not tackled, 4 recovered with peritoneal drainage, and after cæcos-tomy for paralytic distension in one case (Henle).

Mayo Robson [6] has operated upon 6 cases with 2 recoveries. He states that after 59 operations undertaken in the acute stage, 23 re-coveries took place. Dreesman analyses 118 reported cases healed by operation with a mortality of 55 per cent., and of 40 cases treated by tamponade of the pancreas only 20 per cent. died.

If all the cases were published the results would not be so favourable, but every recovery means a life saved, for few, if any, patients ever recover spontaneously from acute pancreatitis.

It has been suggested that the operation should be deferred until the subacute stage of the disease, but this is inadvisable, for the large majority of the patients, if untreated, die in the acute stage, and only the milder cases ever reach the more favourable subacute stage of suppuration.

SUBACUTE PANCREATITIS

Here the inflammation is less acute from its commencement, and the patient survives long enough for suppuration or gangrene to occur. The abscess may burst into the stomach, colon, duodenum, or peritoneum, or it may reach or bulge forwards into the epigastrium or umbilical region, or backwards into the loin generally on the left side.

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[1] Hlava and others had previously shown that the sanious peritoneal fluid and also the exudation within the pancreas are sterile in at least some cases early in their course.
[2] *Ann. of Surg.*, December 1909. [3] *Ibid.*, May 1910.
[4] *Journ. Amer. Med. Assoc.*, May 28, 1910.
[5] *Ann. of Surg.*, 1912, vol. i, p. 23. [6] *Loc. supra cit.*

Spontaneous recovery may occasionally occur from rupture into the alimentary canal, or upon the surface, but if the condition is not treated surgically, death usually occurs from septicæmia, subdiaphragmatic abscess, wasting, or pulmonary complications.

Operation. The abdomen is opened by separating the fibres of the rectus abdominis, above the umbilicus, and to either side of the middle line according to the position of the swelling which may usually be discovered, especially when the patient is anæsthetised. The abscess may bulge forwards either below or above the stomach, and therefore it may be approached through either the gastro-colic ligament or the small omentum (Fig. 229), the most direct route being selected in each case, after carefully protecting the peritoneum by gauze packing. Drainage may be established by means of a rubber tube containing a wick and surrounded with a layer or two of gauze. The wound is then partly closed.

Mr. Mayo Robson [1] recommends a vertical posterior incision in the left costo-vertebral angle for this purpose. Such an incision would certainly be more favourably placed for the purposes of drainage ; great care, however, would have to be exercised in carrying out this plan in view of the important structures which might be injured. This plan is especially suitable for large collections. After incising the muscles a dressing forceps is passed forwards into the abscess.

If the surgeon has not opened the abscess in front, he can then dispense with anterior drainage and close the wound completely so as to avoid the risk of ventral hernia.

In the majority of cases anterior drainage alone will be both necessary and sufficient, and there is little risk of contaminating the peritoneum if care be taken to pack around before opening the abscess.

Either immediately or later, characteristic grey or greyish black sloughs of the pancreas may come away, as in a case that I saw under the care of my colleague, Mr. Dunn, in 1898.

This patient, a middle-aged stout woman, had suffered such agonising pain in the epigastrium and right hypochondrium, that she had acquired the morphia habit. In the last attack a vague swelling appeared above the umbilicus and to the right of the middle line, vomiting became very troublesome, and constipation almost complete. The abscess was opened through the right rectus muscle and gastro-colic ligament. This gave immediate relief, and the patient gradually made a complete recovery.

In one case Mr. Mayo Robson performed a gastro-jejunostomy successfully after an abscess had burst into the stomach and continued to discharge its foul contents into the latter.

Mr. Mayo Robson has recorded 7 operations with 5 recoveries, and has collected 7 others with 4 recoveries. Two of Mr. Robson's 5 patients who recovered from the operation died later ; one after a few weeks from pulmonary complications, and the other from exhaustion and wasting after a few months.

CHRONIC PANCREATITIS

Riedel first pointed out the relation of this condition to cholelithiasis, but to Mayo Robson belongs the credit of defining and drawing the attention of the profession to this important subject.[2] In many cases,

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[1] *Brit. Med. Journ.*, May 11, 1901.   [2] *Loc. supra cit.*

chronic pancreatitis is secondary to impaction of a calculus within the ampulla of Vater or in the lower part of the common bile-duct or the pancreatic duct. But when an operation is undertaken the calculus may have already sloughed out or passed on into the duodenum or may not be discovered. In other cases the condition is due to an infection ascending from the bowel. Occasionally syphilis of the pancreas causes similar symptoms. I have seen two cases where the evidence of this as the cause was conclusive. One of these I watched for over ten years. Chronic pancreatitis was discovered at an exploration eight years ago, and mercury and iodides afforded complete relief for several years. From time to time jaundice has recurred and has been relieved by iodides. About two years ago an exploration was made because colic of a severe nature accompanied jaundice. No stones were found but masses of supposed growths in the liver and pancreas. These vanished with iodides and mercury.

It is due essentially to infection ascending along the pancreatic duct and it has followed typhoid fever as in a case recorded by Moynihan.

The result is a chronic interstitial and parenchymatous inflammation which usually and chiefly concerns the head of the pancreas, which becomes enlarged and hard, so that it closely resembles malignant disease, for which it has been very frequently mistaken during exploratory operations for jaundice and other signs of obstruction of the common bile-duct ; under these circumstances cholecystostomy has been performed and the patient has recovered, much to the surprise of all concerned.

If left too long untreated, the patient may die of obstructive jaundice or rapid emaciation with anæmia. Long continued obstruction to the flow of pancreatic juice may lead to such an amount of destruction of the pancreatic tissue as to lead to diabetes, and similarly the liver may become cirrhotic from obstruction to the biliary flow. Diarrhœa with fatty and offensive stools is common, and trypsin may be absent from the fæces.

Treatment. A thorough exploration should be undertaken through the right rectus, and the presence or absence of any calculous obstruction of the bile or pancreatic duct ascertained, especial attention being paid to the ampullary region.

Any calculus that may be discovered is removed, and this may be enough in some cases, but if there be much sclerosis of the pancreas, or if no calculus be discovered, free drainage of the infective contents of the pancreatic and bile-ducts must be established by performing cholecystostomy, or cholecystenterostomy, or if the cystic duct be obstructed the common bile-duct must be drained.

Cholecystostomy is easier and safer than cholecystenterostomy. Infection of the ducts may take place through a cholecystenterostomy, but the danger of this has been exaggerated, and it is not to be compared with the annoyance of a permanent biliary fistula.

It is almost impossible to distinguish carcinoma of the pancreas from chronic pancreatitis even when the abdomen is opened, therefore it is wise to give the patient the benefit of the doubt and to perform cholecystenterostomy, or if the patient is very ill, cholecystostomy. I have performed cholecystenterostomy upon six patients suffering from chronic jaundice. Three of these are well several years after the operation. The other

three died of growth within a year. My late house-surgeon, Lieut. G. Y. Thomson, published these with interesting comments upon them.[1]

The following two of these cases of chronic pancreatitis are worth quoting in full.

CASE 1. A man, aged 35, admitted on Feb. 16, 1908, for pain in the upper part of the abdomen on the right side and jaundice. For two months he had suffered a good deal from indigestion and pain about the epigastrium and gall-bladder region, often vomited soon after meals, and occasionally had diarrhœa, and soon became jaundiced ; the stools became light-coloured and the urine very dark. On admission the jaundice was a little better, but attacks of pain were very severe, being only relieved by morphia. The pain was above and a little to the right of the umbilicus, extending straight through to the back ; the patient did not become pale and there was no sickness during the attack. The upper part of the abdomen was tender and rigid, especially to the right of the mid-line ; the gall-bladder was palpable. By Feb. 19 the jaundice was worse again, attacks of pain more severe, and the patient was wasting rapidly. Exploration was advised.

Operation. The abdomen was opened through the upper part of the right rectus. The gall-bladder was found to be enlarged. No stones were felt in it or in any of the bile-ducts, or at the common opening of the common bile and pancreatic ducts into the duodenum. The head of the pancreas was enlarged and hard, and was thought to be carcinomatous. A small piece which was removed only showed inflamed pancreas. No stones were felt on palpating the pancreas. Anastomosis was made between the fundus of the gall-bladder and jejunum about 9 inches from the duodenal and jejunal flexure ; suturing was direct with the aid of clamps. The opening was made as large as possible, and three layers of sutures were used. The abdomen was completely closed.

Recovery was uninterrupted, the patient never had another attack of pain, and the jaundice soon disappeared ; he rapidly gained weight and left hospital on March 13, and was very soon at work again as a police sergeant. He remained quite well for nearly four years and then developed a moderate degree of jaundice which persisted in spite of medical treatment. He wasted a little and complained of itching indigestion. His abdomen was opened again, and the pancreas was found to be very small and very hard, with complete obstruction of the common duct. The anastomosis was thought to be contracted, and was enlarged without any effect. It is probable that the jaundice, which is slight and variable, is due to an ascending cholangitis without fever. He still feels fairly well and is doing his work. He has considerable difficulty in digesting fats. He maintains his weight by taking an increased amount of sugar.

CASE 2. A woman, aged 34, admitted on March 3, 1908, had 18 months before felt very ill ; no diagnosis was made, although typhoid fever and influenza were suggested. Seven weeks before admission she had a feverish attack lasting three weeks ; there had been a good deal of fever, a purpuric rash all over the body, a great deal of abdominal pain, also two rigors and pains in the limbs ; a diagnosis of influenza was made. Soon afterwards she had a good deal of pain on the right side and she became jaundiced ; the pain got more severe and the jaundice got deeper and deeper. On admission she was deeply jaundiced and thin. She had attacks of severe pain in the upper and right part of the abdomen ; gall-bladder was palpable ; there was a great deal of tenderness and rigidity just above the umbilicus. A diagnosis was made of obstruction of the common bile-duct, due probably to stone.

Operation. The abdomen was opened through the upper part of the right rectus. The gall-bladder was distended, but no stone was found in the biliary apparatus. The head of the pancreas was considerably enlarged and hard, and no stone could be felt about the pancreatic duct or duodenal papilla. Anastomosis was made between the fundus of the gall-bladder and jejunum. There was a good deal of oozing of blood during the operation ; therefore a tube was placed in the right kidney pouch for drainage. The patient did well for a few days, but three weeks later a subdiaphragmatic collection of sterile blood was drained, after which she rapidly recovered and left hospital well on May 10. She continued in good health and she was seen by me looking very well, early in 1913.

In Mayo Robson and Cammidge's work thirty-nine cases of chronic pancreatitis treated by operation, with only two deaths, are quoted, and the after-histories of these patients are good.

[1] *Lancet*, 1911, vol. ii, p. 221.

PANCREATIC CALCULI

Sir Alfred Pearce Gould removed a pancreatic calculus in March 1896, but the patient died twelve days later. Moynihan was the first to correctly diagnose and successfully remove a stone from the duct of Wirsung in May 1902.[1]
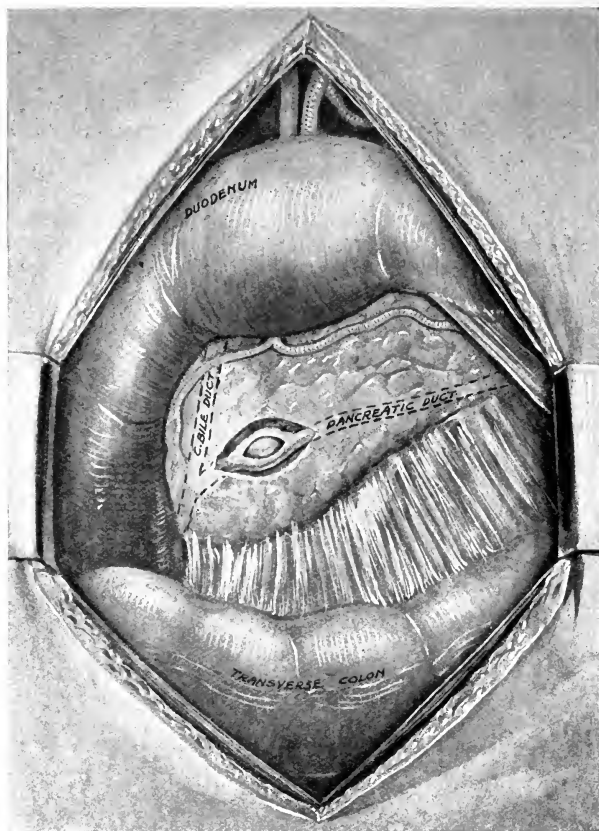
Fig. 230.

The patient "was a lady, aged 57, who had suffered for several months from symptoms which may be briefly described as follows : There was steady loss of health, gradual wasting, irregular pigmentation of the skin, in patches of the colour of café-au-lait (very closely resembling the pigmentation of molluscum fibrosum), persisting attacks of epigastric pain, and uneasiness of the type of hepatic colic, though less severe, and unattended until very late in the history by jaundice, which was then always trivial, though unmistakable, and pain passing through from the front of the abdomen to the middle of the back. There was no rigor or any complaint of sensation of heat or cold. The stools were occasionally frothy and greasy. On examination under chloroform some indefinite swelling could be felt above the umbilicus and a little to both sides of the median line though chiefly to the right."

Moynihan diagnosed chronic pancreatitis, due probably to a pancreatic calculus, which had produced the epigastric colic during its transit along the duct of Wirsung, and had later caused some inflammatory obstruction of the common bile-duct. The

[1] *Lancet*, 1902, vol. ii, p. 355.

abdomen was opened by separating the fibres of the right rectus muscle, and the diagnosis was confirmed. "The head of the pancreas was very much enlarged and hard, the body was less so, but still larger and denser than the normal." A small lump was felt between the duodenum and the pancreas, and upon opening the duodenum and the ampulla of Vater a small soft stone was discovered at the end of the duct of Wirsung, whence it was removed with a scoop. The patient made a complete recovery and was quite well in March 1905.

Mayo Robson, Dalziel, and L. W. Allen have also removed stones from the pancreas.

Mayo Robson [1] successfully removed four pancreatic stones, two from the ampulla after opening the duodenum, and one each from the ducts of Santorini and Wirsung. The ducts and the pancreas were sutured and no drainage was employed.

Pancreo-Lithotomy. Pancreatic calculi may be removed (a) from the duodenum, and through the ampulla of Vater by a slight modification of the operation of duodeno-choledochotomy (see p. 481).

(b) If this is impracticable, the pancreas may be approached through the gastro-hepatic or gastro-colic omentum, and an incision made directly over the stone and parallel to the duct. When the stone has been removed both the duct and the pancreas should be carefully sutured, but drainage should be established from the line of suture to avoid any possible leakage and peritoneal contamination. A sandbag under the back is of great value in bringing the duodenum and the pancreas much nearer the surface.

Link [2] records the remarkable case of a young woman from whose pancreatic duct he removed many small calculi, and then drained the duct through the pancreas tail, which he brought forwards into the abdominal wound, after sewing the pancreatic tissue over a rubber tube leading from the duct. The patient did very well and gained twenty pounds in three months.

PANCREATIC CYSTS AND PSEUDO-CYSTS

Moynihan [3] gives the following classification of these cysts :

(1) Retention cysts.

(2) Proliferation cyst. { Cystic adenoma. { Cystic carcinoma.

(3) Hydatid cysts.

(4) Congenital cystic disease.

(5) Hæmorrhagic cysts.

(6) Pseudo-cysts.

Effusions into the lesser sac of the peritoneum were for long mistaken for pancreatic cysts, partly because the fluid withdrawn from these pseudo-cysts often contained pancreatic secretion, and partly because the pancreas formed a part of the wall of the cyst.

Jordan Lloyd first drew attention to the true nature of the so-called cysts which followed injuries of the upper part of the abdomen.[4] They generally take the characteristic shape of the lesser peritoneal cavity, and if the pancreas has been injured, their fluid contents may have "the property of converting starch into sugar."

[1] *Lancet*, 1904, vol. ii, p. 113.
[2] *Ann. of Surg.*, 1911, vol. i, p. 768.
[3] *Abdominal Operations*, p. 612.
[4] *Brit. Med. Journ.*, 1892, vol. ii, p. 1085.

McPhedran [1] records an interesting example of this condition, and later a true pancreatic cyst developed in this patient, and was probably due to obstruction of the pancreatic duct.

Mr. Kellock [2] describes another instance of " traumatic pancreatic pseudo-cyst " and refers to seven more. In four out of these eight cases the injury was a kick from a horse. In Mr. Kellock's case the collection of fluid became evident after a month. The patient suffered much from pain, vomiting, dyspnœa, and became thin, pale, and weak. The temperature was about 100° F., and the pulse became 120, the respirations 36. Dulness extended from the left loin to the middle line and downwards as far as the umbilicus, and a thrill could be obtained over it. An exploratory puncture through the ninth interspace in the scapular line was made and some turbid fluid was withdrawn. A portion of the ninth rib was resected in the axillary line, and the lesser peritoneal sac opened through the diaphragm, and 88 ounces of fluid were collected, and found later to contain an active diastatic and also a peptonising ferment, acting in an alkaline medium. No micro-organisms were present. " Considerable difficulty was experienced in keeping the cavity drained," although a rubber tube had been sewn in, and a few days later the wound had to be explored, and 70 ounces of fluid were liberated, and another opening was made further back below the ribs. Large drainage-tubes were inserted in the openings, " but seven days later the fluid had again reaccumulated " ; 100 ounces were withdrawn by means of a Boudin's glass tube. Ultimately a gum-elastic catheter was inserted and drainage established into a bottle at the side of the bed, and an average of 28 ounces of fluid was collected every day. After about four weeks from the operation the discharge ceased and the patient made a rapid and complete recovery.

Diagnosis of Pancreatic Cysts. Attention to the following points will generally lead to a correct conclusion. A rounded, elastic, deeply fixed swelling, which may date to an accident, appears, usually in an adult, in the epigastric and left hypochondriac regions, and is generally accompanied (especially when its increase is rapid) by " cœliac neuralgia " —i.e. pains probably arising in the solar plexus—often colicky, or even agonising, and leading to collapse. Dyspepsia, marasmus, and mental depression are often present to a marked degree. The position of the cyst, behind the stomach and transverse colon, is important. This relationship may be demonstrated by percussion with or without inflation of the stomach and colon with gas, and also with the aid of a rubber tube containing an emulsion of bismuth, and the shadow thrown by this upon the X-ray screen (Dalton). Both side to side and front to back shadows should be taken.

The resonance of the stomach is often above the cyst, and that of the colon below it, the centre or most prominent part being dull.

The cyst may present and be dull above the stomach, or below the transverse colon towards the left loin. I have known such a cyst mistaken for hydronephrosis. The segregator will help to distinguish the two conditions, for equal amounts of urine should issue from the two ureters if the cyst is pancreatic, whereas the amount and the characters of the separated urines will be different in hydronephrosis, even if any comes from the left ureter. The urine may contain sugar with pancreatic cyst. The fæces may contain an excess of fat or muscle fibre in a few cases.

Treatment. Dr. Senn showed that the wisest course was incision of the cyst by abdominal section. The results of attempting to extirpate the cyst have been so unsuccessful as entirely to justify his condemnation of this course except in quite exceptional cases. Aspiration is not to be recommended because it is never successful, and is not without danger. It

[1] *Brit. Med. Journ.*, 1897, vol. i, p. 1400.
[2] *Clin. Soc. Trans.*, vol. xxxix, p. 63.

is not even advisable to employ it for diagnostic purposes (*see* footnote 2 below) or for the temporary relief of tension.

(1) **Evacuation and drainage.** The cyst is approached as already described at p. 495. Generally it is best to incise the gastro-colic ligament.

The following case,[1] in which I operated at the request of Dr. Newton Pitt, is a good instance of a pancreatic cyst treated by laparotomy, incision, and drainage :

I received the following history when asked to see the case, August 21, 1889 : The patient was 21. He had received a kick in the abdomen three years before which had confined him to bed for three weeks. Ever since he had been liable to severe attacks of epigastric pain. He had been markedly jaundiced, was emaciated, and suffered a good deal from nausea and depression. The swelling in the epigastric region was convex and uniform, and reached from below the tip of the ensiform cartilage to just above the umbilicus, and laterally to near the end of the eleventh ribs. The tumour gave the impression of being attached to some deep-seated structure. There was transmitted impulse synchronous with the pulse, but not expansile. As the swelling had refilled after two previous tappings.[2] and, as the swelling and the patient's distress were steadily increasing, laparotomy was performed, August 22, with strict antiseptic precautions. An incision, three inches long, was made over the most prominent part of the cyst, an inch and a half to the left of the middle line, extending to within an inch of the umbilicus. The parietal peritoneum having been stitched to the margins of the wound, the lower edge of the liver could be seen moving with respiration in the upper angle, while the rest of the incision was occupied by a smooth reddish surface, which bulged strongly forwards. Taking this to be the front of the cyst, and having ascertained before the operation that the cyst was dull on percussion, I was about to leave this, for twenty-four hours, to become adherent before it was incised. The result proved that, if I had done so, the scalpel would have passed through both walls of the stomach. Before dressing the wound, I again scrutinised the surface of the supposed cyst, and thought I found evidence of involuntary muscular fibre, which threw doubts upon the swelling being a pancreatic cyst. When the supposed cyst was examined between the fingers, it proved to be the empty stomach, stretched very tightly over the subjacent cyst. To get at this, the stomach was drawn upwards, that it might be packed away above under the liver. But here an embarrassing difficulty arose. As I pulled up the stomach, which was tightly jammed between the bulging cyst behind and the parietes in front, the omentum came up into the wound in front of the cyst. The tension of the parts was so great, owing to the rapid increase in the cyst, that there was no room above in which to pack away the omentum. Pushing this to either side, already fully occupied, pulled down the stomach again. I accordingly drew the greater part of the omentum out of the wound.[3] Some of it was tied with catgut, and cut away ; much of it was left heaped up on the abdominal walls of either side of the incision. One or two fine catgut sutures retained the omentum in position. I next scratched through the two layers of omentum, and exposed the surface of the cyst for a space the size of a shilling. There was thus a somewhat conical passage leading from the abdominal incision, through a mass of

[1] My colleague and I reported this case fully (*Trans. Med.-Chir. Soc.*, vol. lxxiv, p. 455). References are given to 30 cases which will be found summarised there by Dr. Pitt. References are also made to 13 cases by Mr. Cathcart in his instructive paper (*Edin. Med. Journ.*, July 1890).

[2] The fluid was alkaline, sage-green, sp. gr. 1013, albuminous, and, under the microscope, showing innumerable collections of globular masses of tyrosin crystals. No leucin could be detected. The fluid in these cysts varies a good deal—sometimes colourless and serous, at others it is red and viscid. It will be seen from the account that follows that on each occasion the aspirating needle must have transfixed the stomach. The same thing, with like harmlessness, happened in one of Karewsky's two cases (*Deut. Med. Woch.*, No. 46, 1890). In two cases the preliminary puncture was followed by evidence of peritonitis, and in two by grave collapse attending the escape of fluid from the cyst into the peritonæal sac. Another possible danger is puncture of the transverse colon, which may be tightly stretched over the cyst. If fluctuation can be detected in the infra-costal region behind, or if a thrill can be obtained here from the front, it will be safer to aspirate from behind.

[3] On another occasion I should divide the omentum above the transverse colon.

omentum, down to the anterior surface of the cyst. This last was very vascular, and so tense that it was not thought advisable to put in a guide-suture. · The patient passed through the next twenty-four hours fairly well. At midnight, August 23, symptoms of collapse set in (hæmorrhage probably took place at this time into the cyst, a complication which must always be probable, owing to the very vascular surroundings). The patient's pulse at 2 A.M. had run up to 163, and his condition pointed to a fatal ending at no distant date. At 3 A.M. I passed a fine trocar into the cyst, and drew off 12 oz. of deeply blood-stained fluid, which was under very high tension. The sac was then incised and a large drainage-tube inserted. A marked improvement at once set in. A slight discharge of dark treacly fluid necessitated changing the dressing twice a day at first. The wound was all healed in two months (vide infra).

On another occasion I should prefer to pack around and empty the cyst at once either by aspiration or by a large trocar and tubing, or by a small incision, keeping the cyst well forwards by means of forceps attached to the cut edges. Then, as the cyst emptied, a finger as a guide having been introduced into the cyst and pushed downwards and outwards below the left infra-costal margin, a counter-opening might be made and a large drainage-tube inserted into the cyst from behind. This would be shortened from time to time, as gradual contraction of the cyst took place. The anterior opening in the cyst could be either sutured, or attached to the margins of the abdominal incision. Mr. Cathcart left the opening in the front of the cyst open, Sir A. P. Gould closed his by suture.

Mr. Caird,[1] acting on Mr. Cathcart's plan of making a counter-opening behind, opened one of these cysts at the back, and not through the anterior abdominal wall, as is usually done. The incision was made along the outer border of the erector spinæ just below the twelfth rib, and a tube inserted. This was kept in for four months, and later on iodine was injected occasionally to promote obliteration of the cyst. The patient was ultimately discharged, with the opening closed. The administration of liquor pancreaticus with the food was thought to have been beneficial. All will agree with what Mr. Cathcart claims for the posterior incision, viz. (1) that the cyst can here be reached extra-peritoneally ; (2) that this incision gives better drainage ; and (3) that by it there is less risk of a ventral hernia, but the anterior incision is far better for exploratory purposes, and moreover anterior drainage has been found to suffice in most cases. I have seen one pseudo-cyst drained successfully through the anterior part of an incision made for the exploration of a supposed hydronephrosis.

The after-history of any case of pancreatic cyst reported as cured by drainage must be carefully watched. It is clear that under certain conditions—e.g. where the cyst is very large, where it has thick walls, and above all where the duct communicates with the cyst and where much of the tissue of the pancreas remains—**recurrence** is almost certain and complete obliteration by drainage probably impossible. As in most of these cases the intimate relation of these cysts with very vital parts does not admit of their being dissected out, we must be prepared to fail sometimes in our efforts to secure a radical cure. This is shown by the sequel to Dr. Newton Pitt's and my case, which was brought, as one treated successfully by drainage, before the Medico-Chirurgical Society (vide supra). About a year later I heard that the swelling had reappeared and that the man was about to be operated on again. Later on I was given to understand that the swelling had reappeared a

[1] Edin. Med. Journ., February 1896.

second time, but I have been unable to obtain the needful information. Dr. M. H. Richardson, of Boston, drew attention to this tendency of pancreatic cysts to recur after drainage. " Pancreatic Cysts apparently cured by Incision and Drainage ; Recurrence ; Perforation of the Stomach ; Death ; Autopsy." [1]   At the necropsy it was found that the head of the pancreas was normal, and that a tube could be passed from the pancreatic duct into the cyst ; about two inches of normal pancreatic tissue were found lying between the cyst and the spleen. From this also a duct could be traced into the cyst. It was very difficult and even impossible at the time of the necropsy to dissect out the cyst from the parts to which it was adherent. Dr. Richardson thinks that in some cases the permanent use of a tube will be needful. Sir A. P. Gould published [2] a case of pancreatic cyst which had been treated by drainage, a sinus persisted in spite of treatment, and, three years later, became the site of epithelioma-tous infiltration. Dr. O. Ramsey, of Baltimore, in a case of a large pancreatic cyst treated by drainage, was obliged to continue the use of a drainage-tube seven months after the operation, as the discharge was still free. [3] Dr. Ramsey thinks that in addition to persistence of secretion the large size of the cyst and the tension under which the fluid escapes when the cyst is opened, point to gland substance being present and still functionally active. The last two features, it will be noticed, were present in Dr. N. Pitt's and my case, which recurred after an apparent cure. Some of these recurrences may have been due to the adenomatous or primarily malignant nature of the cyst, and for this reason it is always advisable to remove some of the wall of the cyst for microscopical examination.

Extirpation. On account of the slow recovery and occasional recur-rence after evacuation and drainage, extirpation has been practised and recommended, but it is not often either advisable or practicable on account of the extensive adhesion to vital parts, and the large blood-vessels in and around the cyst.

Even Mikulicz had to abandon two attempts, and the splenic vessels had to be tied in two instances (Mikulicz and Bilroth). When the cyst is peduncled or chiefly concerns the tail, it may be safely and very properly excised, the pedicle being ligatured, sutured, or clamped.

Mayo Robson [4] collected the records of 160 operations for pancreatic cysts ; 140 of the patients recovered from the operation or were presumed from the records to have recovered. Four of the cases were doubtful in this respect. Out of 138 patients treated by incision and drainage 16 died—a death-rate of 11·6 per cent. Out of 13 complete excisions 3 died (20 per cent.). Out of 7 partial excisions 1 died (14·3 per cent.).

It must be remembered, however, that only the most movable and comparatively small cysts were excised, so that the figures do not repre-sent the comparative danger of drainage and extirpation, the latter of which is only suitable for occasional cases. It is interesting to notice that 8 of the patients died of peritonitis, 2 from shock, 1 from collapse, 1 from intestinal obstruction, and 1 from gangrene of the pancreas. Out of the patients who survived the operation 1 died later of diabetes, 1 from tuberculosis, and 1 from hæmorrhage after a year and a half.

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[1] *Boston Med. and Surg. Journ.*, vol. cxxvi, 1892, p. 441.
[2] *Lancet*, vol. ii, 1891, p. 290.
[3] *Ann. of Surg.*, December 1895.
[4] *Loc. supra cit.*

GROWTHS OF THE PANCREAS

Very few operations have been undertaken for new growths of the pancreas. The most common malignant neoplasm is carcinoma, especially of the head of the gland ; but occasionally fibro-sarcoma occurs.

Mr. Mayo Robson [1] collected records of sixteen operations for the removal of solid tumours of the pancreas, with eight recoveries from the operation, but the prolongation of life was of short duration.

Mr. Malcolm removed an enormous fibro-sarcoma of the pancreas from a child, but the patient died of shock soon after the operation, and the portal vein was found at the autopsy to be full of growth.[2] Sherren records a successful resection of an encapsuled movable sarcoma of the pancreas.[3] Finney records a resection for cystadenoma.[4]

Mr. Mayo Robson records the results of twenty-eight operations for malignant disease of the head of the pancreas. These were undertaken chiefly with a view of making a diagnosis between chronic pancreatitis and carcinoma. Of fifteen cholecystostomies eight recovered, but the longest survived only for eight months, and the average duration of life after the operation was only four months. Out of six cholecystenterostomies only two recovered, and they only survived for a few weeks.

Out of twelve cholecystenterostomies for malignant disease undertaken by Dr. Murphy only two recovered from the operation.

The mortality of the operation has been much reduced by improvements in technic. It is certainly worth doing the operation in doubtful cases, for even upon exploration it is often impossible to distinguish chronic pancreatitis from carcinoma. Surely it is worth while giving the patient the benefit of the doubt, for cholecystenterostomy will almost certainly save his life if the disease is inflammatory ; and in any case he will be relieved of his intolerable itching and jaundice, and his life will be somewhat prolonged. The value of the bile and perhaps some pancreatic juice for digestive and aperient purposes are to be considered in comparing cholecystenterostomy and cholecystotomy, and a greater risk is worth running in order to avoid a biliary fistula.

The following case illustrates these points :

The patient, a man, used to weigh about 13½ stones until July 1910. He thinks he had indigestion early in July and after a week or two jaundice appeared. He had a similar attack in October, five weeks before the date of consultation (Dec. 8, 1910). He had discomfort high in the epigastrium, nausea and anorexia. He had vomited twice, once after bathing, but he was subject to migraine.

The motions were clay coloured lately. Urine had been high coloured until about five weeks ago. The patient had not been constipated of late. He had been in bed a week before consultation. He had worked hard until a week ago.

Examination on December 8, 1910. The patient is a very thin man. He is jaundiced, but not deeply. His skin is dry and rough. Tongue furred. Some anæmia. Arms are very dark. His motions are pale clay coloured. No rectal or colic growth could be found. An enlarged gall-bladder could be felt under slightly enlarged liver, but no pancreatic swelling could be felt.

Diagnosis. Pancreatitis or ? growth of pancreas or duodenum, or, possibly, stone in the ampulla of Vater.

Operation on Dec. 14, 1910. Mr. Plumtre gave open ether. The abdomen was opened through the upper part of the right rectus some of the fibres of which were cut across. A large gall-bladder was at once seen. The common duct was also dilated. The pancreas was enlarged, hard, and fairly fixed. No stone could be felt in the common duct or papilla. It was thought that the condition of the

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[1] *Hunterian Lectures, loc. cit.*
[2] *Trans. Path. Soc.*, vol. liii, p. 420.
[3] *Lancet*, June 3, 1911.
[4] *Ann. of Surg.*, June 1913.

pancreas was probably due to chronic pancreatitis or possibly to carcinoma of the head of the pancreas. The body of the pancreas was also enlarged and some hard nodules were felt along the lower border of it. The liver was slightly enlarged but no growth could be seen or felt in it and none could be felt in the portal fissure. It was seen that it would be very difficult to join the gall-bladder to the duodenum, which was not as movable as usual. It was, therefore, decided to join it to the jejunum about twelve inches from its origin. The gall-bladder was so tightly distended that it was impossible to get any of it into the clamps, until a large amount of thick dark bile had been evacuated. Soft curved clamps were applied to pouches of the jejunum and gall-bladder, while an opening an inch and a half long was made in each of them and the anastomosis was completed with two continuous sutures of fine linen thread reinforced with several interrupted stitches. The packs were then removed and the parts were cleaned. The abdomen was closed, catgut being used for the peritoneum and mass salmon-gut sutures for the remaining layers. The operation lasted about thirty-five minutes and the patient was not much worse at the end of it. Directly he was returned to bed continuous saline rectal infusion was commenced. He had rather a bad night, vomiting a good deal of brown material which was clearly altered blood and bile mixed together. Four pints of saline were given per rectum during the night and only water by the mouth. One dose of pituitary extract was also given. He oozed a little from the wound. This was controlled by putting in another stitch. The abdomen was quite supple. The temperature was normal, pulse about 74, and the patient was in no pain.

The patient returned home on Jan. 5, 1911. The jaundice had not entirely gone, but it was rapidly clearing, especially on the limbs. He had done very well. His weight at date of operation was 11 st. 6 lbs. When he left the hospital it was 10 st. 5 lbs. 12 oz. By Jan. 18 it had increased to 10 st. 12 lbs., and on March 1 it was 11 st. 3½ lbs. But from this time he began to fail and later developed œdema of the legs and ascites. Diarrhœa with oily stools persisted in spite of Pankreon in increasing doses. Growths were felt in the pelvic peritoneum on rectal examination, and the patient died on May 11, just ten months from the onset of his symptoms and six months after the operation, which had made him far more comfortable, and had prolonged his life for several months.

Very rarely it may be possible to remove a growth of the tail or body if discovered very early. Malignant cysts may be occasionally drained with temporary relief. Growths of other organs such as the stomach or the colon which trespass upon the pancreas are nearly always best left alone ; and if the pancreas is either accidentally wounded or a part of it purposely resected, it is essential to drain the wound to prevent contamination of the peritoneum with the secretion that oozes from wounds of the pancreas.

OPERATIONS ON THE KIDNEY AND URETER

NEPHROTOMY. NEPHRO-LITHOTOMY. NEPHRECTOMY. NEPHRORRAPHY. OPERATIONS ON THE URETER

BEFORE undertaking an operation upon any of the urinary organs the surgeon should, of course, ascertain the state of the general health of the patient, and he should also endeavour to gain all the information he can about the condition and functional capacity of each one of the urinary organs. It is especially important before operating upon one kidney to know the state and working capacity of the other. By means of more comprehensive examinations the surgeon may hope to make more accurate diagnoses, and to avoid useless and incomplete operations. Armed with a full knowledge of the value of the other kidney, the surgeon can more easily decide upon the extent of the operative treatment permissible in a given case, as well as the nature of the prognosis that may be given. On the other hand, valuable time must not be wasted on useless investigations, and vexatious and dangerous ones must not be undertaken unless they are likely to lead to useful conclusions. In addition to the valuable information to be obtained from the history, symptoms, physical signs, chemical, microscopical, and bacteriological examinations of the urine, the catheter and the sound, there are other means which may provide more accurate knowledge in some cases. *Cystoscopy, ureteral catheterisation or segregation, skiagraphy, the estimation of the urea in the separated urines, and cryoscopy* may complete the diagnosis made by the older methods.

The surgeon must decide which of these comparatively new methods of investigation to use and rely upon in any given case. Some of them require special skill, and the value of some of them is as yet uncertain. It is well to remember that we cannot afford to reject reliable information obtained from any source, new or old, and that correct conclusions are generally arrived at from a careful consideration of all the available evidence without attaching undue weight to any one sign or symptom.

NEPHROTOMY

Indications. The following are the principal conditions which demand this operation :

(i) **Pyonephrosis and Abscess of the Kidney.** (*a*) When the abscess is due to calculi, these will be removed and the cavity drained, except in special cases where nephrectomy is indicated (*vide infra*, p. 541).

(*b*) When due to unilateral tuberculous disease, it is rarely wise to perform preliminary nephrotomy, for it is usually safer and easier to remove the kidney at once, but occasionally when there is evidence

of disease of the opposite kidney or of other viscera, nephrotomy alone is available. The results, however, when a secondary nephrectomy cannot be performed are, as might be expected, extremely unsatisfactory. Otto Ramsay, of Baltimore,[1] gives the results of fifty-five cases. Of these, four at the most, and probably two only, can be considered as cured.

(c) In a few rare instances pyonephrosis may be due to a stricture or kinking of the ureter. An example of this condition is referred to below under the Surgery of the Ureter (see p. 588).

(ii) **Hydronephrosis.** If the kidney has not been hopelessly destroyed, or the size of the tumour prevents removal, incision and drainage should be employed either as a method of cure or as a preliminary to a secondary nephrectomy. When the other kidney is known to be good primary nephrectomy is better, but in many cases a plastic operation to remove the obstruction of the ureter is practicable and hopeful.

(iii) As an *exploratory operation* for diagnostic purposes for certain obscure renal symptoms. Some of the conditions that have been found are mentioned below under Nephro-lithotomy (see p. 518); in others a calculus will be found. In others again, particularly where the only symptom is hæmaturia, the exploration may have a negative result.

(iv) **Anuria.** This will be dealt with later (see p. 533).

(v) **Nephritis.** Dr. Alfred Pousson read a paper on the surgical treatment of nephritis at the International Congress of Medicine at Lisbon, April 1906.[2] The following summary of his views is taken from the *Lancet*.

" Four operations have been suggested for acute nephritis—namely, nephrectomy, total or partial, nephrotomy, and decapsulation. Nephrotomy acts by relieving tension and by local bleeding. Decapsulation only reduces the compression of the kidney. The mortality of all forms of surgical interference is only 15·4 per cent. and the patients who have survived the operation have done well. This mortality justifies surgical intervention in acute nephritis, but only in severe cases which have failed to respond to medical treatment. Acute nephritis is often unilateral and the affected side can generally be diagnosed, especially by means of cystoscopy and separation of the urines of the two kidneys. In cases where both kidneys are affected the treatment of one often relieves the other. Nephrotomy is the operation of choice for acute nephritis. Nephrectomy should be reserved for cases where there are severe lesions limited to a single kidney. Decapsulation is much inferior to incision of the kidney. In chronic nephritis surgical intervention can do much but it should only be employed where medical treatment can do no more. Nephrotomy is less dangerous than decapsulation and it should be preferred. It is difficult to speak with certainty, but decapsulation seems to be the only operation which gives a hope of a radical cure of chronic nephritis, but it is best to combine with it a unilateral nephrotomy."

I do not recommend any of the above procedures; the results that have been published so far are certainly no better than those obtained by the far safer medical treatment. The same remarks apply to the *Treatment of eclampsia by nephrotomy* introduced by Edebohls and advocated by Chamberland and Pousson in a paper read before the Paris Academy of Medicine, April 3, 1906.

Operation. As this is identical with the first stages of a nephro-lithotomy the reader is referred to the description of that operation (p. 522).

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[1] *Ann. of Surg.*, vol. ii. 1900, pp. 461 et seq.
[2] *Lancet*, vol. i, 1906, p. 1202.

NEPHRO-LITHOTOMY

The following are the chief **symptoms and conditions justifying nephro-lithotomy** :

(1) *Continued Hæmaturia.* I may at once be criticised for putting this first ; and, indeed, it is somewhat difficult to decide which symptom of renal calculus is clinically the most important.[1] On the whole, I am inclined to agree with an old friend, G. A. Wright, of Manchester,[2] who considers " renal hæmaturia as the only single symptom of anything like cardinal importance," if without evidence of nephritis.

A few words as to the character of the hæmaturia of renal calculus and the fallacies which must be borne in mind. It is a hæmaturia of long standing, often repeated, frequently increased by exercise or jolting, rarely profuse, and never producing anæmia, as in growth of the kidney. Always intimately mixed with urine, the tint varies from a bright or deep red (which I think is rare) to a smoky or porter-like colour.

Fallacies : (*a*) Hæmaturia may be absent from first to last. This, an undoubted fact, is one very difficult of explanation. (*b*) Another fallacy is that the hæmaturia of calculus may be only temporary, present for a while and then ceasing altogether. This occurs, though rarely, when a small renal calculus becomes encysted. (*c*) The value of hæmaturia, though only occasional, is shown by a case of Dr. Owen Rees', to which Mr. Morris has drawn attention.

It was that of a young lady with lumbar pains and frequent micturition, which were both put down to the hysteria that was markedly present. After a while, hæmaturia was found to be present on several occasions, and eventually, after death, a mulberry calculus was found in one kidney.

Other fallacies are presented by the host of kidney conditions which may give rise to hæmaturia—namely, (1) the passage of uric acid crystals ; (2) tubercular kidney ; (3) granular kidney ; (4) growths ; (5) increased intra-renal pressure, &c. To these I shall refer later.

(2) *Pain and Tenderness, Lumbar and elsewhere.* (*a*) FIXED LUMBAR PAIN. Characters : Generally dull, gnawing, pricking, or aching, increased usually by exercise, twisting from side to side, or flexing the body.[3] Sometimes it is relieved by pressure of the hand, leading to thickening and vascularity of the parts when they are incised at the operation. (*b*) RADIATING PAIN, for example, in the testis,[4] region of the small sciatic nerve, calf, foot, or in the intestine simulating colic. It is easy to see how readily the pain of a renal calculus, if limited to distant parts, and if occurring without hæmaturia, may mislead. Another point with regard to the pain of renal calculus is the frequency of nocturnal exacerbations. The explanation of this is doubtful, whether, as Mr

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[1] Being convinced of the frequency of errors of diagnosis in renal calculus, Mr. Jacobson has dealt with these fully. I may also refer my readers to his paper, *Brit. Med. Journ.* 1890, vol. i, p. 117.

[2] *Med. Chron.,* March 1887, p. 463.

[3] As in going upstairs ; probably from the pressure on the kidney by the contracting psoas. But the relation to the pain to movement, and the kind of movement which most induces pain, vary greatly. Thus Mr. Butlin's patient is said to have suffered greatest pain when driving, least when riding. Prolonged walking seems the most frequent cause.

[4] In a case of Mr. Butlin's (*Clin. Soc. Trans.,* vol. xv, p. 113) the patient sought relief from severe neuralgia of the right testis, which was generally retracted and extremely tender. Later on it was noticed that these neuralgic attacks were associated with some lumbar pain and tenderness. Complete recovery followed after the removal of a small prickly, calcium-oxalate calculus from the pelvis of the right kidney.

Morris has suggested, from the passage of flatus in the colon, at this time over a stone in the pelvis, or, as I venture to think more probable, as accounting for stone whether in the pelvis or in one of the calyces, to the concentration of the urine, and consequent deposit of crystals, which takes place at night, is unsettled. The fact, however, is undoubted.

> In the case of a patient, aged 58, who had suffered from symptoms of renal calculus for thirty years, and from whose left kidney I removed a huge calculus, the pain at night was often so severe as to drive him from his bed into his garden or the streets of the town in which he lived.

(c) RENAL COLIC. Very acute in character, radiating from the loin, usually downwards, and accompanied often by rigors, nausea, vomiting, profuse perspiration and retraction of the testicle. The attacks are usually recurrent, and vary greatly in severity. The colic may be due to a stone either passing down the ureter or gripped in the lower part of the renal pelvis, and obstructing the flow of urine ; here a stone frequently acts as a ball-valve.

Tenderness. Mr. Jordan Lloyd,[1] in a paper to which I shall have again to refer, wrote thus : " I attach great importance to the evidence to be obtained by immediate percussion over the suspected organ, a method of investigation which has not received that amount of attention to which it is entitled. It is best practised from the loin, just beneath the space between the tips of the last two ribs, and should be made in a direction upwards, forwards, and slightly inwards. It is best for the patient to stand upright before you. The blow should be sharp and decisive, and of force sufficient to affect a structure situated several inches below the surface. It may also be practised from the front, at a point midway between the umbilicus and ninth rib. When a calculus is present, the patient will complain of sharp, stabbing pain at the moment of percussion. Other conditions doubtless give rise to percussion pain, but not of the characteristic stabbing of calculus."

I have tried the percussion test of Mr. Lloyd in many of the cases which have come under my hands for nephro-lithotomy since his paper was published, and I have found it very useful but far from infallible.

Mr. Clement Lucas [2] recommends a new test, which he calls " the stamping test," which " sometimes gives the most remarkable results. The patient supports himself by resting one hand on some firm object, then is told to flex the thigh on the suspected side as high as possible. The psoas muscle being thus strongly flexed, by its contracted belly presses the kidney forwards and outwards. Next the patient brings the limb suddenly down, stamping the heel firmly on the ground. The kidney in this way suddenly loses its muscular support and is caught, as it were, unawares, whilst the jar carried through the pelvis and spine is communicated to it. A sudden acute pain is commonly caused by this manœuvre when a calculus is present. In one case in which I employed this test it answered only too well, for the patient was immediately seized with acute renal colic which necessitated his being put to bed, where he lay for some hours in great agony. It was evident that a stone had been displaced from a calyx and had fallen over the outlet of the pelvis whence it was removed by operation some days later."

[1] *Pract.*, vol. xxxix, p. 178.
[2] *Hunterian Lecture*, 1903 ; *Lancet*, vol. i, 1903, p. 1148.

(3) *Points in the Previous History.* Space will only allow of my noticing a few of those given above, namely, lithiasis and oxaluria, history of previous passage of a stone, history of previous colic.

The history of long-standing lithiasis and oxaluria is of obvious importance, from the fact that the habitual passage of crystals or gravel and the formation of a calculus lie not far apart. But there is another point which has not, I think, received sufficient attention, and that is, that in patients who have habitually, for many years, passed uric acid and oxalate of lime, there is a most serious risk that the minute anatomy of their kidneys will have become seriously damaged by the constant presence of the above crystals. We should all be agreed as to the damaging effect of multiple calculi on the secreting tissue of the kidney. I would suggest that in the future the results on the kidney of the daily passage of crystals of uric acid and lime oxalate must receive sufficient attention before patients at all advanced in life are submitted to nephro-lithotomy. Furthermore, it is obvious that long-continued lithiasis and oxaluria will very likely have led to the formation of bilateral stones.

(4) *Frequency of Micturition.* The co-existence of irritability of the bladder with renal calculus is well known, and may be explained either by nerve disturbance, or by the blood and pus, or the over-acid urine which often accompanies stone in the kidney.

(5) Pyuria, especially when unilateral in origin. Occasionally pyuria is the only sign or symptom of stone, until a shadow is discovered during the routine X-ray examination.

(6) The X-rays afford the most reliable evidence of the presence or absence of a stone in the kidney, but even in the hands of an expert they are not always conclusive. A small stone in the ureter or pelvis of a stout patient is often overlooked.

(7) Cystoscopic examination after the intramuscular injection of indigo-carmine is especially valuable when the X-rays have failed. Under these circumstances the cystoscope has several times enabled me to diagnose obstruction of one ureter, and the subsequent operation has revealed a small stone in the ureter or pelvis.

(8) *Failure of Previous Treatment to give Relief.* I can only touch on one point here, *i.e.* the question of the advisability of trying to exert any solvent action on a calculus in the kidney. Whilst, for myself, I attach the greatest importance to the use of large quantities of water, it is rather because this, by washing out the kidneys, removes collections of crystals, and gets the patient into a better state for operation, than because I believe in its possessing any actively solvent action upon the calculus. I do not forget that Sir W. Roberts has proved by experiments on calculi, both those outside the body and those in the bladder, that urine rendered alkaline by fixed alkali has a distinctly solvent action.

Dr. Ralfe has reported [1] a case of a patient, aged 37, who, after suffering from uric acid gravel for some years, had a violent attack of renal colic, with profuse hæmaturia, no calculus or gravel being discharged. Alkaline treatment was at once resorted to, and for a time afforded relief, but the patient could not be persuaded to continue it systematically. He was then ordered to drink copiously of soft water—filtered rain-water. Two years later he began to pass grit and scales of calculous matter with his urine ; and shortly afterwards, after a severe attack of colic, he passed the shell of what had evidently been a solid calculus.[2]

[1] *Path. Soc. Trans.*, vol. xxxiii, p. 206.
[2] Dr. Ralfe (*Diseases of the Kidneys*, p. 523) points out that the solvent action of distilled water is due to several influences. In the first place, by causing a low specific

But it must be remembered that, as my late colleague Dr. Hilton Fagge pointed out,[1] such solvent treatment is only worth trying in the case of uric acid calculi. He at the same time showed that the greater relative frequency of lime oxalate calculi over those of uric acid, especially in patients after early adult life, is much more marked than is generally believed. Moreover, as Morris [2] points out, it cannot be too strongly urged that, in the presence of definite symptoms of calculus, any prolonged course of palliative treatment is to be deprecated, for during this time the stone may be steadily but slowly destroying the kidney, and so valuable time will be lost.

(9) *Calculous Anuria.* Exploration of the kidney in this extreme condition is urgently called for, although in a few cases recovery has taken place without operation. Morris [3] gives two collections of cases, those operated on and those not operated on. Of forty-eight cases not operated on, ten, or 20·8 per cent., recovered ; of forty-nine cases operated on, twenty-five, or 51 per cent., recovered. These figures speak for themselves.

The most important and difficult point to decide is the question as to which kidney should be explored. If it can be determined which kidney has become the more recently affected, this should be chosen for operation, because this will be the one least destroyed by disease. Apart from the history, abdominal pain, rigidity, and tenderness may help to clear up this point. This subject is referred to later, p. 533.

Conditions which may simulate Renal Calculus. Before deciding to operate on a given case, it must be borne in mind, in addition to what has been already said, that many other diseases may give rise to the same symptoms as renal calculus.

So closely do some of these conditions simulate renal calculus that a correct diagnosis can only be arrived at by means of an exploratory operation, but this is rare with our improved methods of diagnosis. Morris [3] gives a list of no less than forty-four cases occurring in his own practice in which the kidney was explored for stone, and no stone found. In a few of the cases a calculus was passed soon afterwards, so may have been lodged in the ureter at the time of the operation. In the majority of the cases, however, some other morbid condition of the kidney or ureter was found and remedied. So that, although no stone was found as the result of these operations, no harm was done in any (for none were fatal), and good was done in the majority. Morris says : " It is certain that the diagnosis of calculus, though incorrect, was advantageous to the patients, for the very reason that it led to the exploration, and in this way to the discovery of the true cause of the disease."

These conditions simulating calculus must now be severally considered. They may be usefully divided into two groups—affections of the kidney and ureter, and diseases of other organs.

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gravity of the urine, it induces disintegration, since Rainey has shown, experimentally, that bodies placed in solutions of different density to those in which they were formed undergo molecular disintegration. Again, chemical analysis has shown that those calculi that undergo spontaneous disintegration are always poor in inorganic constituents : the use of soft water diminishes the supply of these, even if it does not actually act as a solvent on those forming the outer crust of the calculus, and so increases the tendency to disintegration. Lastly, soft water probably diminishes the catarrh of the urinary passages, and by diminishing the swelling of the mucous membrane allows a small stone to pass which was before obstructed.

[1] *Medicine,* vol. ii, pp. 373, 383.　　　[2] *Hunterian Lectures,* 1898.
[3] *Loc. supra cit.*

A. **Affections of the kidney and ureter which simulate renal calculus.**

(1) *Lithiasis.* I have already alluded to this condition as one which simulates renal calculus by the hæmaturia which crystals of uric acid may cause. Lumbar and testicular pains are also points which mere lithiasis shares with renal calculus. The diagnosis will not be difficult by watching the result of treatment, which only gives relief in the one, but clears up the other. Exercise, again, is a test.

(2) *Tubercular Kidney.* Lumbar pain and tenderness, frequent micturition, hæmaturia, are all common to tubercular kidney and renal calculus. The chief aids in the differential diagnosis are :

(a) *Skiagraphy.* Even now the X-rays may fail to discover a small stone impacted in the ureter. It is often wise to repeat the examination. On the other hand the X-rays may give definite evidence of enlargement of a tuberculous kidney.

(b) *The careful examination of the urine.* With tubercular kidney, the sediment contains caseous matter, and the bacillus tuberculosis. While I am well aware of the occasional want of success in demonstrating the presence of the bacillus in urine as in bone, yet repeated examinations by an expert rarely fail to demonstrate the bacillus. Inoculation experiments are more decisive but take several weeks.

(c) *Cystoscopy.* This is very valuable and nearly always reveals tuberculous disease of the bladder, especially around one of the ureteral orifices, which may be inflamed, œdematous or retracted. After the intramuscular injection of indigo-carmine little or no pigment may be seen to issue from the diseased kidney, and separation of the urine of the two kidneys either by ureteral catheterisation or segregation serves to show whether the disease involves one or both kidneys.

(d) *Early pyrexia.* I do not here speak of the hectic which accompanies the advanced stage, but of the pyrexia which may be an important factor in the diagnosis much earlier in the case. Often intermittent at first, and liable to be overlooked in the anorexia, nausea, and debility which accompany it, later on, and too late, it becomes only too evident and confirmed.

(e) *The failure of the general health and the evidence of tubercle in the lung, testes or vesiculæ.* The discovery of tuberculous disease elsewhere is very important. Mr. Lucas has pointed out that the corresponding ureter may sometimes be felt to be enlarged and tender by vaginal examination.

(3) *Hydronephrosis* due to stricture of the ureter, or a valvular obstruction at the commencement of the ureter. Several remarkable cases of this nature have been described, notably those of Morris and Fenger. These will be referred to later, pp. 586 to 588.

(4) *Slight Pyelitis, not Tubercular.* This condition may, by hæmaturia, pus in the urine, lumbar and testicular pain, simulate renal calculus closely. It is often due to bacillus coli infection, and often occurs in women during or after pregnancy. It may follow gonorrhœa or stricture of the urethra.

(5) *Movable Kidney*, especially if associated with neuralgia, pyelitis, or if recurring with some of the reflex causes of nephralgia to be mentioned below. The following case under Mr. Watson Cheyne,[1] in which

[1] *Brit. Med. Journ.*, 1899, vol. i, p. 17.

there was severe hæmaturia, caused probably by congestion due to kinking of the renal vessels, is worthy of note in this connection.

A woman, aged 40, had a fall, hurting her back, in 1885. This caused great pain and hæmaturia, the urine being bright red in colour. This continued for five weeks, during which time the patient was confined to bed, and then ceased. There was no further hæmaturia for ten years, although pain was present during most of the time. Severe hæmaturia then occurred again, and again stopped after a time. In June 1897, severe hæmaturia and pain came on again, and continued till November, when the operation was performed. No stone was present, but the kidney was found to be freely movable. The kidney was fixed, with the result that hæmaturia ceased immediately and did not recur.

(6) *Aching Kidney.* Under this title Dr. M. Duncan has described a condition, especially common in women, which may simulate renal calculus. Its chief features are a heavy, wearying pain, deep in the side, usually accompanied by tenderness, often great ; the pain may run in the course of the great sciatic or anterior crural, and is frequently accompanied by irritability of the bladder, and by pain in the course of the ureter. The disease is liable to be aggravated by exercise. The chief points in the diagnosis of this condition are, Dr. Duncan points out, the absence of blood and pus, the fact that the " aching " often occurs only at the menstrual periods and is always worse then, from the intimate connection between the kidneys and the generative organs, not only developmental but pathological. A definite nephralgia is also caused sometimes by malaria, as pointed out by Morris, and may be relieved by the administration of quinine.

(7) *Interstitial Shrinking Nephritis.* This condition may simulate renal calculus both by hæmaturia and pain.

Dr. S. West [1] drew attention to the hæmaturia which may accompany granular kidney, and published three cases, aged 21, 19, and 24 ; in the first the hæmorrhage was profuse. Mr. Bowlby [2] also published three cases, aged 73, 49, and 64 ; two of these died, and the kidneys were found markedly granular. He points out the following as distinguishing this condition from renal calculus : The specific gravity of the urine, after the blood has cleared up, only 1008 to 1015 ; tortuous arteries, cardiac hypertrophy, and high arterial tension ; blurred, ill-defined discs, some retinitis and effusion amongst the blood-vessels. The paper concludes with the following warning : " Unless it be recognised that blood may emanate from a kidney which is simply granular, operations may be undertaken for the removal of renal calculus."

With regard to renal pain in granular kidney, this is of two kinds. There is the dull aching generally found, if the case be watched, to be felt across both loins, as well as in one side. Occasionally, though this is rarer, the pain occurs in violent paroxysms, simulating renal colic. This was so in the case to which I have alluded, and to a more marked degree in one brought by Mr. Mansell Moullin before the Clinical Society.[3] If now, in addition to the hæmaturia and paroxysmal pain, there be nausea, passage of uric acid, and frequent micturition, the mistaken diagnosis of calculus may easily be made. Where granular kidney is possible, such a case should be carefully watched, and if the specific gravity of the urine never rises above 1015, the question of operation must be entertained with the greatest caution, and the very great risks most clearly put before the patient.

(8) Renal growths, in these pain and hæmaturia are more independent of jolting and other movements, the bleeding is more abundant, and it is

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[1] *Lancet*, 1885, vol. ii, p. 104. [2] *Clin. Soc. Trans.*, vol. xx, p. 14.
[3] *Trans.*, vol. xxv, p. 60.

as little controlled by rest as it is unlikely to be induced by exercise (Morris).

Other conditions mentioned by Morris as having been found in some of the above-mentioned forty-four cases are—small abscesses, or suppurating cysts, solid renal or perirenal tumours, tense cysts, blood extravasated either under the capsule or within the substance of the kidney, dense adhesions. To these may be added rare cases of villous tumour of the pelvis, nævus of the pelvis, and primary cystic kidney.

B. **Diseases of other organs which may simulate renal calculus.**

X-ray examinations are very valuable here, and cystoscopy during the actual attack of pain may show that both kidneys are excreting indigo-carmine naturally, thus excluding ureteral obstruction. When little or no pigment issues from one ureter, ureteral or renal disease is proved.

(1) *Gastric and Duodenal Ulcer.* Morris has seen a case of gastric ulcer which simulated renal calculus, and the writer has successfully performed gastro-jejunostomy for an ulcer on the posterior wall of the duodenum which had caused severe pain in the right loin, so closely simulating renal pain that the kidney had been explored.

(2) *Intestinal Adhesions.* A case is given by Dr. Tirard.[1] Though (as the kidney was only punctured) the presence of a calculus cannot be excluded in this case, it is very possible that the explanation given below may meet other nephralgias. A schoolboy, aged 12, gave a history of hæmaturia with severe pain, after another boy had jumped suddenly and roughly on his back. There was only this one attack of hæmaturia, but from this time occurred frequent attacks of severe pain, which seemed to return with any sudden jolting movements, a railway journey or a ride in a hansom often proving sufficient exciting cause. It was also noticed that the pain was worse with constipation or diarrhœa. Although no certainty was felt about the presence of a renal calculus, it was generally thought that the symptoms might be due to this. At the operation no stone could be found, though the pelvis and the substance of the kidney were carefully explored with a needle. A firm cicatrix was, however, discovered, circling the capsule of the kidney and the descending colon, and this was so tough and so extensive that it was thought expedient not to divide it. The lad recovered, and is now able to keep fairly free from pain so long as he attends closely to the action of the bowels.

(3) *Gall Stones retained in the Gall Bladder* may be taken for right renal calculus. Dr. Murchison pointed out long ago that they not infrequently coexist. My old friend, G. A. Wright, of Manchester, has recorded [2] a case in which the right kidney was explored for a calculus believed to be in the ureter.

On exploring this tube a hard spot was felt near the brim of the pelvis, and taken for a stone in the ureter. A calculus the size of a pigeon's egg was removed and found to be a gall-stone. Acute peritonitis carried off the patient, and a stone was found to exist in the pelvis of the right kidney, with its apex in the ureter.

While on this subject of nephralgias due to conditions of viscera near the kidney, I may refer to some remarks of Mr. Godlee,[3] in which he insists that repeated attacks of intestinal colic, especially if accompanied by nausea, may be the only symptoms of the presence of either a renal or biliary calculus, and that this fact should lead the practitioner to

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[1] *Lancet*, 1892, vol. i, p. 16.   [2] *Ibid.*, 1885, vol. i, p. 563.
[3] *Pract.*, vol. xxxix., p. 246.

investigate the state of the kidney and urine, bearing in mind the possibility of the symptoms being due to renal or biliary calculi.

(4) *Spinal Disease.* The great difficulty which may arise in diagnosing between certain cases of spinal caries and renal calculus is not yet sufficiently recognised. A writer already quoted from [1] thus alludes to this matter :

"Where a local patch of caries of a vertebral body exists, and especially where deep suppuration occurs and presses upon the kidney, as in a case of my own and one or two others which I have seen, nearly all the symptoms of a calculus have been present. In my own case, without any deformity or tenderness of the spine, there was unilateral rigidity, testicular pain, intermission of symptoms, increased frequency of micturition, nausea during attacks, and oxaluria, with local pain and tenderness. Subsequently an abscess developed, and on exploration a small patch of caries was found, and the kidney was felt exposed in the anterior wall of the abscess cavity. Probably, as in floating kidney, obstruction of the vessels and ureter may arise and cause symptoms, so that pressure of the spinal abscess may disturb the kidney, and quite possibly give rise to hæmaturia."

Mr. Clement Lucas relates even a more striking case.[2]

"*Caries of the spine*, especially in children, may give rise to one-sided backache and radiating pains in front as a lumbar abscess is gradually forming, very similar to what is met with as the result of renal calculus. The pressure of the abscess on the renal vein may even cause hæmaturia, as I once saw very remarkably demonstrated some years ago. I was asked to go to Thetford to meet Dr. M. Beverley of Norwich in regard to the daughter of a medical man. She had spinal disease in the lower dorsal region and lately had been passing blood with her urine. I found a large lumbar abscess which I opened and drained. The blood entirely disappeared from the urine on the second day after the operation. A few months later I received a letter from the father to say that hæmaturia had again appeared. I wrote back : ' Look out for an abscess on the other side of the spine.' This was discovered and opened when the hæmaturia again and finally disappeared. I have seen this young lady as a plump well-developed woman showing little or no evidence of the serious illness which she passed through at the age of nine years."

(5) Diseases of the bladder, such as calculus, papilloma, epithelioma or tuberculosis, sometimes mimic the symptoms of renal disease, and fruitless explorations of the kidneys have been undertaken, before the real seat of the disease has been discovered to be in the bladder ; thus tuberculous disease, villous growth or epithelioma situated at or near one ureteral orifice may obstruct the latter, and produce spasmodic renal and ureteral pain. A coexisting hæmaturia or pyuria is then erroneously thought to have its origin at the seat of pain in the loin.

Routine use of the cystoscope has done much to prevent the occurrence of this mistake.

(6) Appendicitis especially when retro-colic may cause symptoms closely simulating those of renal calculus. This is a frequent cause of error ; thus a distinguished surgeon considered himself to be the subject of frequent attacks of renal colic, until at last a swelling appeared over the appendix, which was removed. Although seven years have passed, there has been no recurrence of colic.

In addition to the above, Morris alludes to having known cases of each of the following conditions give rise to symptoms simulating renal calculus : malignant and tuberculous growths in the intestines, aortic, or cœliac aneurysm stretching the ureter or renal vessels, abscess and calculus in the prostate, ovaritis, and tuberculous disease of the Fallopian tube.

[1] G. A. Wright, *Med. Chron.*, No. vi, p. 642.
[2] *Lancet*, 1903, vol. i, p. 1148.

In some cases it may be difficult to decide which kidney to explore, hæmaturia being the main symptom, and pain being bilateral, indefinite or absent. The cystoscope, the segregator or the ureteral catheter may then decide the point, if skiagraphy and other means have failed to do so.

Operation. The patient is placed, on the sound side, with a firm pillow under the flank, and the upper knee flexed to prevent the body rolling forwards. The surgeon defines carefully the lower border and length of the last rib. That this is not an unimportant detail in renal operations is proved by the following :

Prof. Dumreicher,[1] of Vienna, accidentally opened the pleural cavity during an attempt to remove a pyonephrotic, calculous kidney. At the necropsy it was found that the last rib was rudimentary, that the pleura projected a good deal below the lower ridge of the eleventh rib, and that thus, when the incision was carried upwards, the accident had become unavoidable. Dr. Lange, of New York, has called attention to the investigatons of Dr. Holl,[2] of Vienna, on the frequency of rudimentary development of the last rib, and the importance, therefore, of counting the ribs before intended operations on the kidney. Dr. Lange[3] himself shows that in some cases, which are, however, exceptional, even normal development of the twelfth rib may demand extreme caution, as the pleura may project considerably below it.[4]

The surgeon, having defined the length and position of the lowest rib, makes an oblique incision,[5] at least 4 inches long, $\frac{1}{2}$ inch below it, and beginning about $2\frac{1}{2}$ inches from the spine. The skin and fasciæ being divided, the muscles, viz. anterior fibres of the latissimus dorsi, the external and internal oblique, are cut through by light sweeps of the knife. As soon as the yellowish-white lumbar fascia is reached, any bleeding vessels, which have been temporarily secured by forceps, are tied or twisted. If the last dorsal nerve cross the incision, it, together with its accompanying vessels, should be drawn aside and left untouched if possible. The lumbar fascia is next incised near the inner end of the wound, thus exposing the quadratus lumborum. While the peritoneum is pushed forwards, the incision in the fascia is prolonged. The perirenal fat, covered by the thin transversalis fascia, now bulges into the wound and is incised at the upper and inner corner of the wound, so as to avoid wounding the peritoneum which is in front and the colon which is below. With two large retractors opening up the wound, the surgeon, keeping near the inner angle of the wound, cuts through the fat[6] till he can see, or easily feel, the posterior surface of the kidney, which he carefully separates from its bed of fat by sweeping his fingers around it in contact with its fibrous capsule. No attempt is made to withdraw the kidney until this separation is complete. During this first stage of the operation the surgeon will find sometimes that the muscles are much thickened by reflex irritation from the presence of the

[1] Quoted by Dr. Lange, *loc. supra cit.*
[2] Dr. Holl found that in quite a considerable percentage the last rib is so abnormally short that it does not reach as far as the outer border of the sacro-lumbalis, or so rudimentary that in some cases it more resembles a transverse process ; and that in these cases the lower edge of the pleura passes from the lower boundary of the last dorsal vertebra almost horizontally towards the lower edge of the eleventh rib.
[3] *Ann. of Surg.*, vol. ii, October 1885, p. 286.
[4] In other cases the reverse condition may be present ; though the last rib be rudimentary, the pleura may pass from the lower edge of the eleventh dorsal vertebra horizontally towards the eleventh rib, and thus be altogether out of danger.
[5] I prefer this to any other incision, for it gives a direct and free access, without material risk of hernia.
[6] If this fat is very abundant, some of it should be carefully torn away ; poorly vitalised, it is prone to suppurate tediously and to delay healing, when the urine is septic.

stone, and, if the stone has been associated with suppuration and peri-renal inflammation, the tissues will be more or less densely blended and matted together.

An assistant now makes powerful pressure on the abdomen, so as to push the kidney up into the wound, this being widely opened by full-sized retractors, aided, if needful, by an assistant pulling up the lower ribs with his hand. Thus the surgeon is enabled to examine the organ, systematically : the finger is first directed to the pelvis, then to the posterior surface ; next, by passing the finger round the outer border, to the anterior surface, which, as Sir Henry Howse has pointed out,[1] can be done effectually by pressing the kidney back against the firm, unyielding psoas. The sensation given by a stone has been compared to that of the uncut end of a pencil (Morris), or the last joint of a finger (Howse).

If the above means fail, the incision must be made sufficiently free, especially in a fat patient, and a deep loin, to expose the kidney more thoroughly. Additional room may be gained by enlarging the wound at both ends, and incising upwards the part of the lumbar fascia which covers the posterior surface of the quadratus muscle, or by making use of König's incision, in which the muscles are cut through as far as the rectus, and the peritoneum pushed forwards, or, as recommended by Morris, continuing the original incision downwards and forwards to a point one inch above and in front of the anterior superior iliac spine. Morris[2] also sometimes removes the distal two or three inches of the twelfth rib, subperiosteally, after exposing its outer surface through a vertical incision carried upwards from the oblique one. He also incises the quadratus lumborum if the muscle is broad, and the ligament of Henle if obstructing the view. A small stone in the kidney will always be liable to be over-looked ; but a surgeon does not give his patient or himself a fair chance who is content with exposing part of the kidney through a limited incision, and then trusting to punctures with a needle. In every case the pelvis and upper ureter must be examined.

If the stone cannot be felt either in the pelvis or after palpation of the posterior and anterior surfaces of the kidney, this should be drawn up and out of the wound as far as possible, and again examined.

When the kidney cannot be brought out on to the loin, the incision should be made large enough to see what is being done. Needling a doubtful spot sometimes serves to locate a stone.

Failing all these methods, and if the radiogram indicates a stone, the kidney itself or the pelvis [3] must be incised, and explored with a sound

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[1] *Clin. Soc. Trans.*, vol. xvi, p. 93.
[2] *Surg. Diseases of Kidney*, vol. ii, pp. 185, 209.
[3] In the following case, under the care of Mr. T. Jones, of Manchester (*Med. Chron.*, June 1887, p. 212), opening the pelvis alone sufficed to find the stone, after systematic exploration of the kidney had failed : " The forefinger was passed to the anterior surface, and the organ grasped between the finger and the thumb; nothing, however, could be found. The kidney was then carefully explored by systematic puncture with a long needle, also passed towards the pelvis, but no calculus could be felt. An incision, sufficiently large to admit the tip of the index finger, was then made through the kidney substance into the pelvis by means of a fine bistoury. On introducing the forefinger, a small stone was discovered firmly lodged in one of the superior calyces. Small, straight, lithotomy-forceps were introduced, and the stone thus removed." Very free hæmorrhage attended the above incision, but it yielded to pressure made with carbolised sponges, and kept up for five minutes. The patient made a good recovery. The calculus, consisting of lime oxalate, weighed twenty grains. This plan of opening the pelvis might be thought to cause a risk of leaving a urinary fistula, but the numerous cases in which calculi have

and the finger (*see* Fig. 231). During this part of the operation, hæmorrhage is prevented either by compressing the renal vessels between the left thumb and index finger, or, as advised by Cumston of Boston,[1] by means of a special curved clamp which he had devised for the purpose. Cumston finds that pressure may be kept up by this means as long as half an hour without harm resulting, the operation being accomplished without any loss of blood. Morris[2] makes a small cortical incision, which the exploring finger fills and even distends, thus controlling the bleeding to a
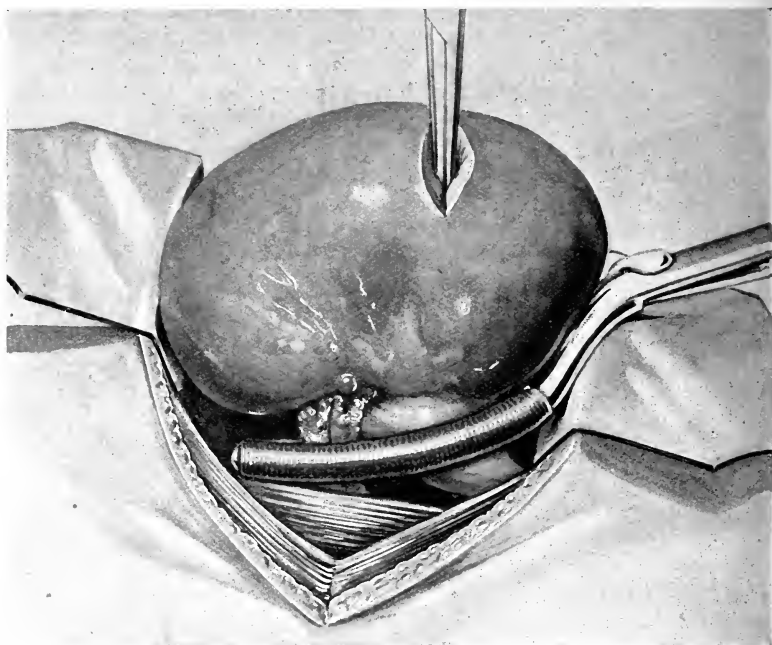
Fig. 231. The right kidney exposed and its vessels clamped while a stone is removed. The cortical incision is transverse. When the stone is large it has to be made longitudinally along the free border of the kidney.

great extent during the exploration. A thorough and systematic examination of each calyx is carried out by means of the index finger or a short-beaked child's bladder-sound. The beak should be not more than a third of an inch in length, a stem of about seven inches, and the size of a No. 3 English catheter. The position of the calculus having been made out, it is removed, if small, through the incision in the convex border of the kidney. If this is inconvenient, or the stone large, an incision is made directly over it, and the stone then removed. Unless an incision through the cortex has been already made a small pelvic stone is best removed by a small pelvic incision made directly over it and afterwards sewn up in the reverse direction to avoid narrowing the origin of the ureter (*see* Fig. 232). Catgut is always used, for permanent

been removed from the renal pelvis with entire success do not support this view. If the pelvis be dilated this spot should be chosen, otherwise I generally incise the convex border at its lower part, at a spot more readily kept under notice if much bleeding follow.

[1] *Ann. of Surg.*, vol. xxvi, p. 320.
[2] *Surg. Diseases of the Kidney*, 1901, vol. ii, p. 187.

sutures form nuclei for stones. On the other hand a large pelvic stone branching into the calyces is best removed through the cortex in order to run less risk of prolonged fistula, although a cortical wound carries with it far more risk of hæmaturia. Apart from pyonephrosis the bleeding is controlled by catgut sutures.

If the stone is irregularly branched, some laceration of the kidney tissue may be spared if the calculus is broken up and removed in two or more fragments. Mr. H. Morris [1] thus alludes to two difficulties which these stones may cause : " A large branched calculus may be so tightly embraced by the kidney substance, and the kidney may be so uniformly
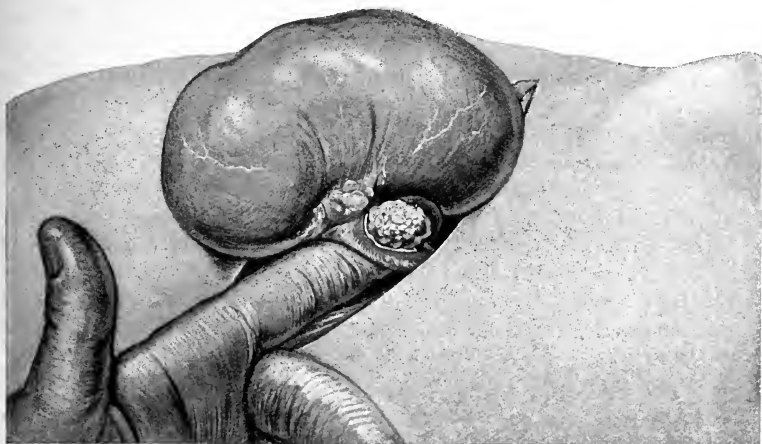
FIG. 232. Nephro-lithotomy. Stone in pelvis. Kidney delivered and pelvis held up by finger, which is left in position until the incision has been closed with fine catgut.

even on its surface, that nothing more than a very firm tough organ may be thought to be present, and even on passing a needle into it no sense of calculus, but rather the resistance of a tough fibroma, is met with. In these cases much difficulty will be experienced in freeing the stone from its encasement, and for this purpose the moderately free use of a bistoury will be requisite. It is astonishing how some of the large branches of a calculus may escape detection unless the surgeon is aware of the firmness with which they are embraced by the tough renal tissue. After removing several large pieces of calculus I have, in one or two cases, thought that all must have come away, because with my finger in the kidney nothing but renal tissue could be felt, and yet, after scratching through at some points where the resistance was greater than elsewhere, branch after branch of calculus has been exposed, showing that more of the calculus would have been left behind than had been removed had the operation been discontinued, because no further actual contact with the calculus was made with the finger in the interior of the kidney."

If the kidney be enlarged, with expanded calyces, the result of calculous hydronephrosis or pyonephrosis, on searching through the pelvis after a stone, the gush of fluid and collapse of the expanded kidney may cause the stone to disappear, and thus lead to much trouble in its removal.[2]

[1] *Brit. Med. Journ.*, November 16, 1889.
[2] Symonds, *Clin. Soc. Trans.*, vol. xviii, p. 181.

Mr. Morris [1] gives two other conditions which may prove embarrassing. " Sometimes in feeling over the kidney a portion of it, varying in size from a sixpence to a five-shilling piece or more, is found soft, flaccid, thin or fluctuating, and there is nowhere any sense of hardness or increased resistance, such as might be expected from even a phosphatic stone. On incising or puncturing this soft part, pus or purulent urine is drawn off, but no stone is felt ; but on introducing the finger into the interior of such an organ, a small calculus may be detected, freely movable within an enlarged pelvis, or fixed in a dilated calyx, or possibly at the apex of a funnel-shaped pelvis. Such cases show that aspiration, or simple incision and drainage, are insufficient, and that one ought not to be satisfied with anything less than a digital examination of the interior of the pelvis, of the calyces and commencement of the ureter. Another arrangement of the calculus is sometimes found in sacculated kidneys. The renal cavity may be wholly or partially filled by a soft, mortary, phosphatic calculus which gives no sound or resistance to the scalpel or trocar, and yet, on incising the renal substance and inserting the finger, a stone of considerable size may be felt."

One more difficulty, which must, however, I think, be a very rare one, is inability to reach the pelvis in a stout patient. Mr. Mansell Moullin relates [2] a case of this kind :

The patient, a lady, aged about 40, and rather stout, had suffered for ten days from total suppression of urine, believed, and correctly so, to be due to a calculus having blocked the upper end of the ureter of the only kidney which remained functionally active. The left kidney was explored by the usual lumbar incision. " There was no difficulty in finding the kidney, although it seemed to lie unusually deep. Its surface was smooth and uniform, but very firm, and it was not possible, either by rolling the patient on to her back, or by hooking the kidney outwards, to pass the finger sufficiently far on to the anterior surface to feel the pelvis. The kidney was punctured and explored by dressing-forceps and sound, but no stone detected. The operation was successful in that urine soon began to escape, but the patient sank with pyelitis and increasing asthenia on the twenty-third day. The necropsy showed no trace of a right kidney. The left was much enlarged, and an oval uric-acid calculus was impacted in the ureter at its commencement, lying nearly in the middle line of the body.

If after free incision and thorough exploration of the kidney no stone is found, the ureter must next be explored throughout its whole length by passing a No. 3 English bougie or catheter down into the bladder. Morris advises that this step be taken in all cases, whether a stone has been found in the kidney or not ; this is certainly a wise thing to do. Urine or injected coloured solution should be withdrawn by the catheter from the bladder ; the surgeon is then certain that the passage is clear. The catheter may be passed through the incision in the kidney into the ureter. If, however, the orifice of the ureter cannot be hit off in this way, Morris advises a small puncture in the posterior aspect of the infundibulum, through which the catheter can be more easily passed into the ureter. After the exploration this incision can be closed by a catgut suture.

Should a stone be found to be impacted in the ureter, it must now be exposed and removed. The following description of the methods of reaching the different parts of the ureter is chiefly based on the lines laid down by Morris : The original oblique incision is prolonged downwards and forwards to a point one inch above and in front of the anterior superior iliac spine, and, if necessary, still further forwards towards

[1] Loc. supra cit.　　　　　　[2] Clin. Soc. Trans., vol. xxv, p. 57.

Poupart's ligament, and then, parallel to this structure and one inch above it, as far as the level of the internal abdominal ring, or even farther. Through this incision both the abdominal and pelvic portions of the male ureter can be exposed, and the abdominal part and upper half of the pelvic portion in the female. When the calculus is low down I prefer making an incision in front through the linea semilunaris and displacing inwards the rectus muscle and peritoneum.

Since the ureter is frequently dilated behind a stone, after the calculus has been reached with the finger in the manner described, it can generally be gradually pushed up the dilated ureter towards the kidney. If possible this should be done, for two reasons : in the first place, the higher in the ureter the more accessible will this structure be for removal of the stone and suture ; and, secondly, damage to a portion of the ureter already probably inflamed or ulcerated by the calculus will be avoided, and thus more rapid healing ensured.

In order to remove the stone the ureter must be incised over it in a longitudinal direction with a sharp knife. The wound in the ureter is then immediately closed by means of catgut sutures passing through the outer coats only, the number of sutures depending on the size of the incision in the ureter. Incisions made into the kidney can usually also be sutured. When, however, the kidney substance has been much lacerated in the removal of a large calculus, or when pus is present, sutures are better dispensed with. For incisions into the infundibulum, Lembert sutures of fine catgut are employed. Incisions in the renal parenchyma may be closed in the following manner : Several sutures of medium-sized catgut are used (if too fine, they will cut through). They are passed deeply through the kidney by means of long, curved, round needles, three to five sutures being used, according to the size of the incision.

These sutures are passed and tied before the compression of the renal vessels is relaxed, Cumston [1] suturing the kidney before removal of the clamp. In this way two very important advantages are gained— the prevention of hæmorrhage from the kidney, and also usually the prevention of leakage of urine ; the result is that primary union of the incisions generally takes place, and rapid healing of the whole wound and early convalescence thus ensured.

A drainage-tube is now passed from the posterior angle of the wound down to the kidney or the incision in the ureter, in order to allow of free drainage should leakage of urine occur. The rest of the wound is then closed, stout salmon-gut sutures being passed through the whole thickness of the parietes. When these are placed but not tied the muscles may be brought together with catgut.

If, however, the kidney has been much lacerated, or if for any other reason no sutures are placed in the kidney, a full-sized drainage-tube must be passed down to the kidney in order to allow of free drainage ; or if there is free oozing the wound may be packed with gauze, which is left in position for twenty-four hours. The ends only of the wound must be sutured in this case, and the dressings changed as often as they become soaked with urine.

A stone may be missed at the operation, and come away from the wound, or be passed later on *per urethram*. An instance of the former is given by Mr. Bruce Clarke.[2]

[1] *Loc. supra cit.* [2] *Illus. Med. News*, p. 4.

After-treatment. The chief points here are : (1) The meeting of shock after a prolonged operation. (2) The patient's attitude in bed should be recumbent but with pillows placed behind the shoulder and ileum of the affected side ; pressure on the wound is thus avoided. Later the patient may be propped up for the better drainage along the ureter. (3) If severe bleeding occur, a subcutaneous injection of gr. $\frac{1}{4}$ of morphia is given at once and the wound is plugged with gauze and firm pressure applied. (4) The dressings are changed as soon as they are soaked, and the tube is removed on the third or fourth day unless discharge continues, when the tube should be gradually shortened ; this is likely to be necessary where there has been much interference with the surrounding parts or where pus has been present in the kidney. (5) Rectal salines until vomiting has ceased, but water, coffee or tea can be given by the mouth from the first to allay thirst, moisten the mouth, and promote urinary secretion. (6) Care must be taken to relieve the bladder by passing a catheter if necessary. (7) Flatulent distension of the abdomen is often troublesome and can be relieved by a turpentine enema, and by minim doses of peppermint oil given by the mouth. (8) If suppression occurs, saline injections into the rectum or subcutaneous tissues are indicated. Intravenous injection of saline solution and pituitary extract may also be tried.

Lastly, it may be pointed out that the life-histories of these cases should be followed up most carefully, to see how far the cure remains a complete one ; to aid this, the patient should pay lifelong attention to his diet, habits, exercise, &c.

Difficulties in Nephro-lithotomy. (1) An insufficient incision and a narrow ileo-costal space. (2) Abundant fat, *e.g.* in the subcutaneous tissues, around the kidney, and extra-peritoneal, rendering the wound very deep. (3) Rigidity, and perhaps thickening, of the muscles, due to the irritation of the stone. This condition was present in a very marked degree in a patient from whom I removed a small calcium-oxalate calculus. No amount of anæsthetic seemed to have any effect on this condition. Fortunately the loin was a thin one, and the stone very obvious on reaching the pelvis. (4) Matting of the parts around the kidney, rendering it difficult to explore this organ, its different parts and relations, exactly. (5) An indurated condition of the kidney itself from the irritation of a stone. (6) Troublesome flatulent distension of the colon. This is not at all uncommon. The bowel should be packed away with a gauze roll, pushed deeply into the front of the wound, one end of the gauze is always clipped to the towels. (7) Opening the peritoneum. This accident occasionally occurs in difficult cases. If the wound be carefully sutured, there will be no serious consequences.

(8) A stone present, but very difficult to detect. This may be due to (*a*) its small size, especially if it lies deeply in a calyx, or is surrounded by very indurated kidney tissue. A very small stone may cause severe symptoms.

Thus, in one case, a stone, weighing but fourteen grains, and situated in the top of the ureter, quite incapacitated the patient from any work. In another case, a very small stone, firmly fixed in a calyx at the upper part of the kidney, caused severe hæmaturia and pain.

The following case, under the care of Dr. Murphy, of Sunderland,[1] shows still more clearly what urgent symptoms a tiny calculus may cause :

[1] *Brit. Med. Journ.*, 1891, vol. i, p. 757.

The patient, aged 39, had been a complete invalid for nine months, owing to repeated attacks of renal colic, which morphine failed to relieve, the administration of chloroform being frequently required. At the operation, "a very small stone, about the size of a hemp-seed, escaped with a flush of blood," when the kidney was incised. The site of the stone is not given. A good recovery followed.

How impossible it is to detect some stones, without incision of the kidney, is shown by a case published by Mr. Morris : [1]

This authority, with all his experience, after thoroughly exploring the kidney, compressing it all over with the finger and thumb, and also after puncturing it, failed to detect a stone which lay in a hollowed-out calyx. Though the calculus was the size of a small marble, it was so thickly surrounded by kidney-tissue that, even after the removal of the kidney, the position of the stone could not be detected by pressing on the kidney with the fingers as it lay on a table. The patient made a good recovery.

(β) A sacculated kidney, into one of the sacculi of which a small stone may fall and be hard to find.

(9) A stone on the anterior surface of the kidney, especially if near the entrance of the vessels. (10) A very large or a branching stone. Mere size does not necessarily create difficulties in extraction, though, owing to the changes entailed in the kidneys, the general health, &c., by the long duration of a calculus, the prognosis is rendered very much less favourable. A branched calculus presents, of course, much greater difficulties.

Mr. Bennett May has published [2] an excellent instance of this kind, in which he successfully removed a very large, somewhat S-shaped calculus from a man aged 34, with symptoms of sixteen years' duration. Though the stone weighed 473 grains, and was three inches long, manipulation failed to make it out distinctly, but acupuncture detected it at once.

Mr. Footner, of Tunbridge Wells, removed a calculus weighing 822 grains, or nearly two ounces. The patient made a good recovery, but a sinus persisted, through which, on two occasions, a millet-seed calculus was passed.[3] A calculus far exceeding the above was brought by Mr. D. Day, of Norwich before the Clinical Society.[4] This calculus, mainly phosphatic, weighed 1331 grains. The patient made a good recovery, with a sinus persisting in the loin. A calculus larger than either of these is mentioned at p. 533.

(11) A stone which breaks up rapidly. Another condition allied in difficulty is where a calculous deposit rather than a distinct calculus is present. This is more grave, as the deposit here will usually be phosphatic, and point to coexisting pyo-nephrosis. (12) Multiple calculi. Stones (usually minute in size) numbering over 60 or 100, have been removed on several occasions. In such cases it is always possible that the minute calculi have been retained, owing to a larger calculus, e.g. in the pelvis or ureter, blocking their exit. (13) A very mobile kidney. The importance of having an assistant to push the kidney well up into the wound has already been insisted on. It is essential to have this done both for detection of the stone and for its removal, in order to avoid needless disturbance of the surrounding parts, or the kidney may be secured with sutures at the commencement.

Mr. May [5] explains the remarkable fact that his large stone was not felt when the kidney was thoroughly exposed, by the fact that the organ fell forwards and thus embarrassingly increased the depth of the wound.

[1] *Med. Chir. Trans.*, vol. xlviii, p. 69. The woodcut (p. 73) shows well the relation of the stone to the surrounding kidney.
[2] *Clin. Soc. Trans.*, vol. xvi, p. 90.
[3] *Brit. Med. Journ.*, 1892, vol. ii, p. 69.
[4] *Trans.*, vol. xxvi, p. 24.
[5] *Loc. supra cit.*

(14) A kidney situated very high up under the ribs, especially if there be firm adhesions around it. In such a case, it may be necessary to remove the distal two-thirds of the last rib, care being taken to preserve the pleura. (15) A kidney, the pelvis of which it is difficult to reach owing to the stoutness of the patient.

Question of Nephrectomy during a Nephro-lithotomy. In several of the above conditions the question of the advisability of removal of the kidney will arise, *e.g.* where the kidney has been much handled and repeatedly incised, where the stone is large and branched and difficult of removal, where many stones are present, or where one is present and very friable, where the kidney is much altered by pyo- or hydro-nephrosis.

In such cases the surgeon will be guided by the age of the patient ; the knowledge he possesses as to the condition of the other kidney (the amount of urine, &c.) ; the proportion of the urea excreted by each kidney, the evidence of skiagraphy of the opposite kidney, &c., the degree to which the kidney he is operating on has been disturbed from its relations, and its structure interfered with ; the amount of disease, *e.g.* number of sacculi, condition of pus contained in them, the thinning of the cortex, &c. Finally, the length of time that the operation of nephro-lithotomy has already lasted, and the condition of the patient, must be taken into account. Where the patient is young, where the other kidney is healthy, where the kidney operated on is much damaged by previous disease, where several stones are present, nephrectomy, either now, or a little later, is indicated ; of these, immediate removal of the kidney is preferable if the patient's condition admits of it.[1] But the question is a very different one where the kidney is a large one after its

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[1] An instructive case which was under my care illustrates well many of the above difficulties, viz. multiple and large calculi, a mobile kidney, the question of nephrectomy arising during nephro-lithotomy, and the formation of multiple calculi in one kidney without symptoms. In February 1888 I was asked by Dr. Goodhart to see a case of probable renal calculus. The boy, aged 15, had been admitted with abdominal pain and grating of an indistinct and delicate nature in the left renal region. This kidney was slightly enlarged. When asked to localise his pain, the patient pointed to the region of the *left* kidney and the *left* loin. This kidney being explored was found to be occupied by irregular nodulated masses. The kidney being incised, hosts of calculi, comparable only to a gravel-pit, were found in the calyces and pelvis, the chief nests being at the upper and lower extremities. The former of these, lying as they did high up under the ribs, gave much trouble. To get at them the kidney-tissue was again scraped through directly over them, and many of them thus reached. The chief difficulty of the operation, in addition to the number of stones, was the great mobility of the kidney, though this organ was well pushed up from the front. The condition was perhaps due to the almost entire absence of surrounding fat. When I realised the condition of the kidney, I expressed myself in favour of nephrectomy, as the organ was almost useless, as the stones were so numerous, and as a prolonged attempt at removal would produce more shock in so weakly a subject. One or two less important points in favour of nephrectomy were the mobility of the kidney and the entire absence of adhesions. Dr. Goodhart's counsel was, however, against this step, owing to the small percentage of urea—this had never been above 1·2 per cent., and often less. I accordingly continued ; when forty-six calculi had been removed and the operation had lasted three-quarters of an hour, the pulse failed so ominously that I was obliged to desist. Very little blood escaped as long as the opening was plugged with the finger, but considerable oozing followed as the finger brought out the stones. The patient never rallied well, and died three hours and a half after the operation. The necropsy showed a little ecchymosis around the left kidney ; this still contained calculi at its upper and lower parts. The *right* kidney, of which the boy had never complained, also contained a large number of stones. Its substance, though much wasted, still contained a fair amount of secreting substance. The condition of the opposite kidney thus abundantly justified my old friend's opinion. Feeling that unsuccessful cases of nephro-lithotomy have not been sufficiently published, I brought this and the case at page 531 before the Clinical Society. A detailed account of each will be found, with ten others, in the *Transactions*, vols. xxii, p. 198, and xxiv, p. 155.

fluid contents as well as a stone have been removed ; or where it is a case of multiple calculi in a suppurating, damaged kidney. Nephrectomy should, as a rule, be deferred here, and the kidney thoroughly drained, for (1) additional shock and loss of blood will be avoided. (2) The condition of the opposite kidney, very possibly calculous also, will be made clearer by waiting. (3) The bulk of the kidney will be lessened by drainage. (4) Though a source of discomfort (if an open sinus persist) it may still do some important work. Occasionally carcinoma develops in a calculous kidney and may be suspected when there is unusual induration of the kidney or pelvis around the stone. The author found this condition in a man aged 65, who had had a stone in the left kidney for over 40 years. The shadow of the stone extended from the eleventh rib to the crest of the ileum. The patient died of recurrence of the growth within a year of the nephrectomy.

Causes of Death after Nephro-lithotomy. Very few unsuccessful cases have been published ; the following appear to be most common causes of after-trouble :

(1) *Hæmorrhage.* A most interesting case of hæmorrhage, fatal on the seventh day after nephro-lithotomy, was brought before the Clinical Society,[1] by Dr. Stevenson and Mr. Butler Smythe :

Several small and one larger stone (this one being tightly fixed in the pelvis and ureter) having been removed from a kidney, the site of hydro-nephrosis, the patient did well, save for a temperature which was 103° on the third and fifth days and all along very variable, until the sixth day, when bright blood and urine were passed both by the urethra and by the wound. On the seventh day about half a pint of bright bloody urine was drawn off from the bladder, and death took place soon after, with symptoms of internal hæmorrhage. The kidney was found enormously distended with blood-clot and bloody urine. The opening made at the operation was small and blocked up by clot. Embedded in the kidney substance, close to the pelvis, was a round spiked calculus, which had ulcerated into a branch of the renal artery just at its entrance into the kidney, and had given rise to profuse bleeding into this dilated organ.

(2) *Shock.* This may be lessened by bandaging the limbs firmly over gamgee tissue before an operation which is expected to be difficult and tedious. It may be combated by saline infusion, warmth and injections of pituitary extract.

The following possible causes of hæmorrhage after nephro-lithotomy must also be remembered :

A young Welsh miner, with all the symptoms of renal calculus well marked. At the operation two calculi were easily found and removed from the lower part of the right kidney. About three hours after the operation the usual soakage of urine had taken place through the dressings ; but it was noticed to be unusually brightly stained with blood. When the dressings were removed blood was seen to be trickling through the tube which I had left in contact with the wound made in the lower part of the outer border of the kidney. Dr. Bligh, now of Caterham Valley, and then house-surgeon, plugged the wound, and, the patient passing into a state of collapse, resorted to saline infusion. On my arrival at this time, I found that the patient had partially rallied. Similar bleeding followed about two hours later, the wound was replugged, and transfusion again resorted to ; but the patient sank seventeen hours after the operation. At the necropsy nothing was found in the wound beyond some coagula and ecchymosis round the kidney, and a very small calculus, which I had overlooked when the two others were removed. There was marked contraction of the mitral valve. It is very difficult to estimate the loss of blood in such a case, but it was thought not to exceed six or seven ounces, and there were no coagula. The operation was of the simplest kind, but the marked pallor of the patient's face ought to have led me to inquire for a cause beyond that which I too readily took for

[1] *Trans.*, vol. xxii, p. 214.

granted, viz. the pain, &c., set up by the renal calculi. I am not aware of any case that has been published in which surgical hæmorrhage has been associated with a contracted mitral valve, but I have been given to understand that parturient women with the above lesion are especially liable to the peril of flooding.

Another possible cause of hæmorrhage after nephro-lithotomy is where calculi are associated with a growth in the pelvis of the kidney. Mr. Battle has recorded a most interesting instance of this : [1]

At a lumbar nephro-lithotomy several oxalate calculi were removed and a villous growth scraped away from the lower anterior aspect of the pelvis. The patient resumed work, but the hæmaturia returned and became profuse and constant, and the kidney was removed about eighteen months after the first operation. The surface about the pelvis was papillated and firm, and the microscope showed evidence of a new growth at this spot, but whether this was a simple papilloma or a squamous epithelioma remained doubtful.

Hæmorrhage may be treated by tightly packing the wound and applying firm pressure. Nephrectomy may have to be done in a few cases.

(3) *Cellulitis.* If it has been needful to incise or tear the kidney freely, if the urine is foul, and the bleeding has been arrested with difficulty after imperfect and repeated plugging, this may be readily brought on.

(4) *Uræmia*, if the other kidney is the site of calculous disease or disorganised. This was chiefly the cause of death in the case following.

The patient was a solicitor, aged 58, of sedentary life, and gouty history, who had suffered from attacks of right renal colic off and on for upwards of thirty years,[2] these attacks having become increasingly fierce for about six months. Occasionally he had had slight pain on the left side, and on the morning fixed for the operation he passed two small, fawn-coloured calculi of lithic acid and lithates. These were quite insufficient to account for all his suffering, and as prolonged and careful treatment had entirely failed, and as his " life was not worth having at the price," the operation was proceeded with, and the huge renal calculus figured removed. This was effected with the utmost ease, as the stone, from its size and hardness, was readily detected occupying the distended pelvis of the kidney. A profuse jet of venous blood followed its removal with lithotomy forceps, after it had been loosened by a scooping movement of the finger. The hæmorrhage was at once arrested by sponge-pressure kept up for a few minutes. All went well for the first week, save for persistent oxaluria, which no treatment could remove. The patient was able to sit up and read ; appetite returned, and the wound was healing well. On the sixth day a change for the worse set in, first much flatulence and nausea, then constant restlessness, followed by coma, ending in death on the morning of the eighth day. I cannot doubt that the opposite kidney was here also the seat of stone, and its tissue too much impaired to admit of recovery, though I was unable to obtain a post-mortem examination to verify this. I should add that the urine in this patient before the operation was acid, of sp. gr. 1018, and without sugar or albumen. The quantity passed was natural, and the urea sometimes normal, sometimes slightly deficient.

Dr. Whipham and Mr. Haward [3] have recorded a case which, with my own just given, points urgently to the importance of surgeons being permitted to explore earlier :

The patient, aged 56, had for " several years " been troubled with " gravel." The symptoms here were chiefly indicative of calculous mischief in the left kidney,

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[1] *Brit. Med. Journ.*, 1895, vol. i, p. 1206.
[2] This long duration of symptoms was unfavourable. Mr. Keetley was more fortunate in a case equally long standing, in a much younger patient (*Brit. Med. Journ.*, 1890, vol. i, p. 134). A gentleman, aged 44, for thirty years had not passed twenty-four consecutive hours without pain. Mr. Keetley removed 150 calculi from the right kidney. A large rough calculus had blocked the way into the ureter for the numerous smooth calculi which formed behind it. The patient made a good recovery.
[3] *Clin. Soc. Trans.*, vol. xv, p. 123.

but there was some tenderness on the right side as well. The urine here was 1006 sp. gr., alkaline, and contained pus. The left kidney was explored, and found in a state of pyo-nephrosis ; no calculus was found, but a copious discharge of pus took place soon afterwards, giving great relief. The patient a little later again lost ground, and the wound was thoroughly explored a second time, but the patient sank a few hours after this, a month after the first operation. The left kidney-pelvis was much dilated in its upper part, and communicated with a large peri-nephritic abscess. The right kidney contained a large branching calculus.

Modern methods of examination have done much to diminish the number of deaths from uræmia, by enabling the surgeon to press and the patient to accept operation earlier, and by preventing the surgeon from operating on unsuitable cases with deficient functional capacity of the other kidney.

(5) *Septicæmia.* This condition may be induced by the wound becoming foul, a complication which can always be prevented after removal of small stones from healthy kidneys. But where pyo-nephrosis exists, it may be impossible to keep the wound sweet from the first.

And it is to be noted that septicæmia may occur after a nephro-lithotomy, successful as far as the removal of the stone goes, after a considerable interval, where pyo-nephrosis coexists. This is an additional reason for carefully considering the advisability of performing nephrectomy in such cases.

Dr. Shepherd, of Montreal, has published [1] a very interesting instance of this kind :

Nephro-lithotomy was performed in a patient aged 26, who had suffered from symptoms of stone for seven years, with no tumour, and pus in the urine. An enormous, unbreakable stone of triple phosphate was removed with much difficulty from the left kidney. It weighed 4 oz. 7 dr., and measured $3\frac{1}{2}$ inches in length and 9 inches in circumference. The tissue of the lower part of the kidney exposed seemed healthy, and no pus being evacuated it was thought best not to remove the organ. The wound continued to discharge pus, and the temperature varied correspondingly for three months and a half after the operation, when septicæmia set in and proved fatal. The necropsy showed that the upper part of the kidney, which was not exposed, consisted of large communicating sacs, containing over 10 oz. of fetid pus, and a number of irregular branched calculi. Dr. Shepherd points out that the fatal septicæmia was undoubtedly due to these abscesses, showing the need of thorough exploration in all cases where a large stone has set up grave changes, and of extirpation in most of them.

THE TREATMENT OF CALCULOUS ANURIA

Although spontaneous recovery from this very grave condition may occasionally occur, it is certain that an early and suitable operation is by far the best treatment. Morris [2] found that only 20·8 per cent. cures occurred in 48 cases treated without operation, whereas 51 per cent. out of 49 cases recovered after operation. Out of 56 cases collected by Legueu, 28·5 per cent. recovered without operation ; it is probable that the obstruction was never complete in some of these cases.

Before operating, the surgeon should remember, that the stone is nearly always in the ureter of the only functional kidney, but that both ureters may become simultaneously obstructed in some cases, and also that two exceptional cases have been recorded in which a vesical stone closed the orifices of both ureters.[3] Morris draws attention to the three important factors in the production of calculous anuria.

[1] *Philadelphia News,* April 23, 1887 ; *Ann. of Surg.,* vol. vi, August 1887, p. 185. The right kidney is stated to have been perfectly healthy, but double its normal size.
[2] *Surg. Diseases of the Kidneys and Ureters,* vol. ii, p. 159.
[3] Morris, *loc. cit.*

(1) " A long-standing change in one of the kidneys causing a diminution if not suppression of its function ; or else a congenital anomaly (absence or atrophy).

(2) " A recent or recently aggravated lesion of the principal kidney. This lesion is mechanical, and caused by a calculus.

(3) " A reflex inhibitory effect upon the disorganised kidney, leading to complete suppression of its imperfect functional power."

The surgeon may restore the function of the principal kidney by a prompt removal of the obstructing stone, or failing this he may simply form a temporary fistula in the loin ; the other kidney may then regain its use.

Diagnosis. Calculous anuria can be readily distinguished from the temporary reflex suppression that may follow operations on the lower urinary organs, by the history, and from the uræmia of Bright's disease, also by the history and by the absence of the early and characteristic symptoms of non-obstructive uræmia, such as headache, nervous disturbances, coma, and convulsions. The subject of calculous anuria may remain so well for many days, that it may be difficult to make him realise the gravity of his condition.

It is not always easy to tell the side of the principal kidney and the exact position of the calculus which has recently obstructed its ureter, but every effort must be made to determine these points, for the operation must be performed on the side of the healthiest kidney, which is nearly always the last affected.

A history of previous attacks of renal colic on one side and of a sudden recent onset of colic on the same side associated or rapidly followed by anuria, may indicate the affected side with more or less certainty, but if the last attack of colic, which has been followed by anuria, be on the other side the obstruction is practically certain to be on that side. Rigidity, tenderness and, more rarely, swelling on one side may confirm the diagnosis.

When no history of value is available, palpation may discover tenderness or rigidity over one kidney or ureter, although the subjects of anuria are usually too stout to allow palpation of the ureter. Rectal and vaginal examination may enable the surgeon to feel a calculus low down, and Morris has detected a stone in the ureteral orifice after dilating the female urethra, and such a calculus has also been seen through the cystoscope. Examination of the ureteral orifices by means of this instrument may add a link to the chain of facts required for accurate diagnosis. Mr. Clayton Greene [1] records a case in which it was fairly clear from other evidence that the obstruction was on the right side. The cystoscope showed a healthy right ureter, but the left orifice was distended with some whitish material which was thought to be a phosphatic stone. In this case the cystoscope proved that the calculus was not in the vesical part of the ureter, but it is clear, that, taken by itself, the appearance of the left ureter might have led to a wrong conclusion and an exploration on the wrong side. In cases of partial anuria, the cystoscope may serve to show which kidney is the principal one, especially when indigo-carmine has been injected into the muscles of the thigh.

If one kidney is known to have been diseased for some time, and especially if it has been explored by an operation, the recent obstruction is almost certain to be on the opposite side. When one kidney

has been removed and anuria suddenly supervenes some time afterwards, it is imperative to explore the remaining kidney, but this has not always been done; thus a young woman had her left kidney removed for tuberculous disease. Some months later she was taken to another hospital suffering from anuria, which was considered to be due to tuberculous disease of the remaining kidney, but the autopsy disclosed a small calculus impacted in the right ureter and a hypertrophied healthy kidney.

With certain precautions, radiography may give information which may serve to complete the diagnosis by localising the stone, but a negative result must not be relied upon, because a stone which is large enough to obstruct the ureter may yet be too small or too transparent (uratic) to give a shadow in a fat subject. A positive result may also mislead, for a large calculus may be present in the pelvis of the other kidney, and only a small one in the ureter last obstructed. To arrive at a diagnosis, all the facts available must be reviewed and too much reliance must not be placed upon any one sign.

It must not be forgotten that cancer of the uterus and of the bladder may, rarely, cause sudden anuria, and lead to a hasty diagnosis of calculous anuria, but a thorough examination ought to prevent this mistake.

Morris relates a case of polycystic disease of both kidneys, which led to error. A history of passing gravel and a stone was very misleading in this case.[1]

The Nature of the Operation. In most cases it is best to explore the kidney which is considered to be the principal one through the usual incision in the loin, and to remove any stone that may be discovered in the pelvis or the upper part of the ureter. Morris states that in twenty out of thirty cases, this incision would have served to remove the calculus at the primary operation. If a calculus cannot be found in this way, a ureteral catheter should be passed downwards to locate it. Sometimes it may be removed by prolonging the incision, or through a separate extra-peritoneal incision in the groin, if the calculus is lower down. In grave and late cases, however, it will be wise not to endanger the life of the patient by prolonging the operation unnecessarily, and to defer what may prove to be a difficult and long operation until the patient has recovered from his immediate danger; by forming a fistula the surgeon will have done all that is urgently required to save life, *i.e.* to re-establish the secretion of urine.

If it be known beforehand that the stone is too low to be reached from the loin, extra-peritoneal ureterotomy should be performed at once, the stone removed through a longitudinal incision, and a catheter passed down into the bladder to make certain that the passage is clear. The incision into the ureter may be partly closed by catgut sutures, but it is not safe to invert the edges and thus to narrow the lumen of the only ureter, unless the latter be dilated at the site of the incision.

Blood clot in the lower part of the ureter may be sufficient to prevent or delay the return of urinary secretion as pointed out by Mr. Clayton Greene.[2] In any case a drain must be placed near the ureter to prevent possible urinary extravasation.

If the stone be known to be impacted at or near the lower end of the ureter, primary nephrotomy may be done in grave cases, and the calculus

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[1] Morris, vol. i, p. 168. [2] *Loc. cit.*

may be removed later, if not naturally passed. In one case a stone has been removed through the rectum.

Garceau [1] removed a stone which was impacted near the lower end of the ureter through an incision in the anterior vaginal wall. The operation only took ten minutes, and it was completely successful.

Sometimes, although very rarely, it may happen that all the efforts of the surgeon may not suffice to enable him to decide upon which kidney to operate. He must then explore one kidney through the loin, and if this be found to be atrophied or greatly diseased he must perform a nephrotomy on the other side. This is better than doing an exploratory laparotomy, for it may be very difficult to find and examine the ureters, especially in fat subjects; and even if a calculus be found it is not wise to try to remove it through the peritoneum for several reasons. The contents of the ureter above the stone are very likely to be septic, and it may be necessary to drain the ureter, which is more safely done extra-peritoneally; if the incised ureter be sewn up, it may leak into the peritoneum later. Moreover, palpation of the kidneys may mislead the surgeon, the largest kidney being the most diseased one in some cases. Even if a correct diagnosis be arrived at by a laparotomy another incision is necessary to drain the kidney and remove the calculus, as in Mr. Duke's case.[2] In this case all that the surgeon could discover with his hand in the abdomen was that the right kidney " was apparently a little larger than the left." On this slight evidence the right kidney was opened through the loin, and two calculi discovered in the pelvis; one of these, weighing 3·2 grains, was removed later, and the patient recovered, although she had suffered from complete anuria for ten days.

Cabot advocates exploratory laparatomy,[3] if other methods fail to indicate the site of the recent obstruction. He relates two very interesting cases, in each of which the operation failed to discover the calculus, but probably served to dislodge it. In one case bimanual examination through a median laparotomy and an incision in the loin failed to discover the calculous obstruction. In the other patient only a lumbar nephrotomy was performed. Both patients recovered.

One of the most brilliant examples of what nephro-lithotomy can do in some cases of suppression of urine is shown by a case brought by Mr. R. C. Lucas before the Medico-Chirurgical Society,[4] and before the International Congress of Medicine meeting in London about twenty-five years ago :

The patient, aged 37, had had her right kidney, a " mere shell, containing masses of stone weighing twenty-one ounces," successfully removed in 1885. Three months later she was seized with agonising pain in the back and left loin. Suppression of urine quickly set in, and on the fifth day a calculus was removed which was exactly of the shape to act as a ball-valve to the top of the left ureter. The patient made an excellent recovery, and was quite well when shown by Mr. Lucas at the International Congress in 1913, about thirty years after the nephrectomy.

But in many cases of suppression the indications are less clear, and there is often much difficulty in deciding which ureter is blocked, owing to the deficient history. An excellent instance of such cases, in which the surrounding difficulties were most successfully met, is recorded by Dr. Fraser and Mr. Parkin, of Hull : [5]

[1] *Boston Med. and Surg. Journ.*, April 21, 1904.
[2] *Lancet*, 1904, vol. ii, p. 174.   [3] *Ann. of Surg.*, October 1904.
[4] *Trans.*, vol. lxxiv, p. 129.   [5] *Lancet*, 1893, vol. ii, p. 688.

The patient here suffering from suppression of urine was 74 years of age. Beyond the evidence pointing to obstructive anuria, there was very little to throw light on the condition of the kidneys, or which organ should be explored. As the patient had been observed by her friends to support the left side in walking, and as there was deep-seated tenderness in this loin, Mr. Parkin explored the left kidney from the loin. The organ was enlarged, distended, and hypertrophied. About six ounces of urine escaped when the kidney was incised along its convex border, the last portion to come away being mixed with some pus. No stone was found, and the cause of the suppression must remain obscure, as the patient, though 74, made a good recovery, with a sinus from which most of the urine passed.

The above cases show the importance of knowing the history, and' where this is deficient, making a most minute examination, no point being considered too trivial to be pieced in with others, before it is decided which kidney is the working one and now obstructed, and which is obsolete.

The Time for Operation. Any operative interference should be undertaken, if possible, long before the final stage of constant hiccough and vomiting, subnormal temperature, irregular pulse, tremor, and drowsiness. As soon as the diagnosis becomes certain an operation should be resorted to, for it must be remembered that if the obstruction be too long continued, its removal may not relieve the suppression. A few patients have recovered after suffering from complete anuria for ten or more days, but others have died after three or four days. Cases of incomplete obstruction last much longer.

The writer removed two small stones from the left ureter of a very stout lady who had suffered from anuria for eight days. She was greatly distended, vomiting brown offensive material. She was dyspnœic and cyanosed. She made a good recovery and remembers little or nothing of her grave illness. Within seven hours of two operations she passed 6 pints of urine laden with urea. She had been given four pints of saline solution in the axillæ. The opposite kidney had probably been destroyed six years earlier by an impacted calculus.

Anuria following injuries is much less hopeful, owing to concomitant injuries. The following are examples :

Mr. Cock recorded [1] the case of a young man who died comatose on the eleventh day after an accident. All the symptoms of the original injury and the subsequent peritonitis subsided in a few days, save that the catheter withdrew nothing but blood. The autopsy showed a ruptured single kidney. In Mr. Poland's case [2] the complete suppression of urine which followed an injury was due to thrombosis of the renal vessels of one kidney, and rupture of the pelvis on the other side.

Mr. Butler, of Guildford, records [3] a case of suppression of urine lasting thirteen days. The necropsy showed that the ureter of the only working kidney (the left one) was greatly distended with urine and plugged by a solid hard body in about its centre. This proved to be a venous thrombus, which, formed in one of the veins in the kidney, had passed through a rent in the kidney tissue into the pelvis and ureter. Here the suppression came on four days after a blow on the abdomen. No symptoms had pointed to renal disease, and, save that the blow was on the left side, there was nothing to tell on which side the obstruction was.

NEPHRECTOMY

Indications. (i) *Renal tuberculosis* when proved to be unilateral, when the general health and strength of the patient are good enough to warrant the operation, and when there is no evidence of active phthisis or of serious tuberculous disease elsewhere.

(*a*) Primary nephrectomy is always to be preferred under the above

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[1] *Path. Soc. Trans.*, vol. i, p. 293.   [2] *Guy's Hospital Reports*, vol. xiv.
[3] *Lancet*, 1890, vol. i, p. 79.

conditions, but occasionally (b) secondary nephrectomy has to be undertaken after the kidney has been temporarily drained, a discharging sinus or urinary symptoms persist, and the general health is not improving. Secondary nephrectomy is more difficult and dangerous owing to the presence of troublesome adhesions and extension of disease into the surrounding tissues. The operation should be performed without delay while the kidney is still comparatively small and movable, and before the disease has extended along the ureter or into the bladder. The risk of general tuberculosis is also to be borne in mind. There is no evidence to show that tuberculous disease of the kidney ever heals, although its symptoms and signs may vanish when the kidney has been slowly destroyed and remains only as a fibro-caseous mass ; but for the very few that survive this painful and tedious process many more succumb to this most fatal disease. Over twenty years ago Mr. Jacobson strongly advocated early operation.

"I would most strongly urge this course (early exploration of the kidney) with a twofold object : (1) to clear up the case [1] and (2) to perform nephrectomy if the kidney is found to be the site of so fatal a disease. If I am told of the unwisdom of this step, owing to the probability of both kidneys being affected, I would reply that, as a rule, both kidneys are not affected at an early stage. Thus Dr. Fagge [2] gives a list of thirteen cases which show 'the characters of tuberculous disease of the kidney at its commencement.' In only three of these were both kidneys affected, and in all these tubercular mischief was present in the bladder also. If during this early exploration one or two pyelitic dilatations are found, extirpation of the kidney should be performed while the organ is still small and movable, and before the rest of the genito-urinary tract becomes involved.

"I need not remind my readers of the miseries which lie before a patient with established tubercular kidney, the results of ulceration of his bladder, and the usual course downhill, arrested, it may be, for a little while by nephrotomy and drainage."

Mr. Jacobson's experience of drainage alone in established tubercular kidney was most unfavourable, the relief being slight and short-lived, and not arresting long the hectic and increasing debility. On the other hand, in four cases in which he was able to perform nephrectomy early the results were most satisfactory. In four others the recovery, though less complete, was very satisfactory. Finally, in two the disease was too advanced in both for the result to be satisfactory. This was before the modern methods of early accurate diagnosis were available. The present writer's results in fifteen cases have been very gratifying, although one patient died of general tuberculosis six months after the nephrectomy.

Pousson [3] found that out of sixty-three cases of nephrectomy thirty-nine died in the first year from the spread of their tuberculosis or complications arising from incomplete operation. Twenty-four were alive, some of these were known to have survived for two, five, and ten years, but all of them had fistulæ.

Ramsay [4] gives the results of 191 cases of primary nephrectomy for renal tuberculosis. Of these 106 were noted as cured, 31 were improved, 37 died within one month of the operation, and 17 died at a later period.

[1] Brit. Med. Journ., 1890, vol. i, p. 117.
[2] "Fagge's Medicine," vol. ii, p. 488.
[3] Lancet, August 11, 1900.　　　[4] Loc. cit., p. 513.

Forty-nine cases of secondary nephrectomy after a previous nephrotomy are also given. Of these 18 died shortly after the operation, and 23, or 46 per cent., were cured. Of the 37 deaths resulting from primary nephrectomy, 9 were due to uræmia, 3 to tuberculosis of the other kidney, and 2 to amyloid degeneration of the other kidney. These 14 deaths serve to emphasise the importance of thorough investigation of the capacity of the other kidney before nephrectomy is decided upon. For although the second kidney, as mentioned above, is not often affected in early cases, yet when the case only comes under observation in the more advanced stages, it will very possibly be diseased.

Pousson [1] strongly advocates primary nephrectomy at an early date, giving its mortality as 21·79 per cent., whereas that of secondary nephrectomy is 30·76 per cent.

Mr. David Newman [2] writes as follows on the important subject. "Dr. Samuel West [3] claims that the disease is difficult to diagnose in the early stage. In this I fear I cannot agree ; and with regard to treatment he practically advocates a do-nothing policy, completely contrary to the teaching of modern surgery, and to a considerable extent based upon the belief, not supported by facts, that renal tuberculosis is in the great majority of cases bilateral early in the history of the disease. And in the last paragraph he says : ' All that I wish now to do is to protest against regarding the removal of a tubercular kidney as an operation to be lightly decided on. It is a very grave act, requiring the most serious consideration and in all cases involving grave risks. The very ease and success with which the mere operation can now be done renders this caution, I think, the more necessary. The question is not whether the operation can be safely and successsfully done, but what will be the condition of the patient afterwards, and how far his chances of life will be altered for better or worse.'

"Every careful surgeon will accept this general statement or opinion, but he will also remember that in the present position of renal surgery there is as great responsibility in refusing an operation as in advising one, and that by adopting the former course during the time that elapses between the onset of the disease in the kidney and the invasion of other parts the surgeon may allow to escape a valuable opportunity of saving the life of his patient. Since physicians have come to appreciate the value of recognising urinary tuberculosis at an early stage the results obtained by the surgeon have greatly improved."

"Now by bacteriological examination of the urine, inoculation experiments, segregation of the urine, and the employment of the cystoscope the surgeon can obtain objective proof of the presence of tuberculosis in the urinary tract long before the subjective evidence is sufficient to justify a diagnosis. ' Unfortunately, when a patient is not suffering much actual pain or serious inconvenience it is difficult to convince him of the seriousness of his condition, but in all cases of primary renal tuberculosis the problem must be seriously placed before him and nephrectomy advised.' [4] The diagnosis I find can often be made so early in the history of the case that the surgeon is beset with difficulty. He has proof of the presence of tuberculosis in the kidney, but the patient suffers

[1] *Lancet*, August 11, 1900.
[2] *Ibid.*, 1912, vol. ii, p. 1735.
[3] *Ibid.*, vol. ii, p. 1318.
[4] Newman, "The Surgical Aspects of Early Renal Tuberculosis," *The Practitioner*, July 1911.

so little, and his general health is so excellent, that it is difficult to convince him of the impending danger of his position.

"Primary nephrectomy is now looked upon by urologists as the only remedy, and is resorted to when the disease is known to be limited to one kidney; and this can be determined with considerable accuracy by ordinary diagnostic methods, aided by cystoscopic examination and bacteriological research. I am sorry Dr. West does not give any evidence to support his statements. I may say that I collected statistics of operations in all stages of the disease [1] published from 1891 to 1908, and found that during that period lumbar nephrectomy for tuberculous disease gave a mortality of 27·4 per cent. and abdominal nephrectomy 33 per cent. Now we find that when the disease is limited to one side and there is no tuberculous disease elsewhere, nephrectomy results in cure in 30 per cent., with an operative mortality of about 10 per cent This is taking general statistics, but in the hands of surgeons of great experience the cures are in a larger proportion, and the mortality is about one half, namely 5·8 per cent. I may now take Walker's statistics,[2] giving the remote results in 210 cases of nephrectomy : Reported as well, 79 cases ; recovered, 83 cases ; cured, 20 cases ; good results, 4 cases ; improved, 7 cases ; not improved, 2 cases ; improvement not maintained, 15 cases. I think it will be admitted that these statistics convey a different impression from that contained in the remarks made in Dr. West's address."

"Further, Dr. West says, 'When the disease in one kidney is advanced enough to be capable of certain diagnosis the chances of the other kidney being affected too are very considerable . . . .' This depends, of course, upon the methods employed in making the diagnosis and the stage at which the disease is detected, but let that pass, and permit me to quote a passage from Watson and Cunningham : [3]

"*Clinical evidence of unilateral renal tuberculous infection.* The testimony of this nature upon the unilateral occurrence of renal tuberculosis is derived from, and based upon, the examinations of the urines drawn separately from each of the two kidneys, and from the facts with regard to permanency of the cures or entire absence of evidence of the existence of renal tuberculosis, subsequent to nephrectomy of the kidney which is known to be invaded by it. Upon the evidence of this character, such surgeons at Krönlein, Israel, Kümmel, Rafin, Kelly, Bevan, Reynaud, Casper and Hurry Fenwick assert that the process, at the time at which the patients were examined by them, was confined to one kidney in from 50 to 80 per cent. of the cases.

Or, taking the disease not at the stage when it should be presented to the surgeon, but when it has done its worst and has come under the review of the morbid anatomist rather than the clinical pathologist, Halle and Motz [4] found in 131 cases of renal and ureteral tuberculosis examined by them post mortem, in 89 the disease was confined to one side, in 42 it was bilateral."

Should the condition of the other kidney still remain doubtful after the available methods of investigation have been exhausted, then it may become necessary to examine it by means of an exploratory incision. If the ureteral catheter can be used the need for this operation can scarcely arise. Edebohls [5] advised a lumbar exploration, and this is doubtless

[1] Newman's article, " Operations on the Kidneys and Ureters," Burghard's *Operative Surgery*, vol. iii, p. 403.
[2] Quoted by Watson and Cunningham, vol. ii, p. 401.
[3] Newman, *Diseases and Surgery of the Genito-Urinary System*, vol. ii, p. 390.
[4] *Annales des Maladies des Organes Génito-Urinaires*, Paris, 1906, vol. xxiv, 161–241
[5] *Ann. of Surg.*, April 1898.

the safer and more certain method. The disturbance caused will be comparatively slight, and is more than balanced by the additional security that the surgeon will feel when proceeding to perform nephrectomy a week later.

As it is necessary at least to see the kidney in order to be sure that it is healthy, it is clear that an examination through an abdominal incision only serves to show the presence of the kidney. Mr. Barling,[1] however, recommends palpation of the opposite kidney through an incision into the peritoneum at the anterior part of the usual lumbar incision. This plan is certainly simpler than making a separate abdominal or lumbar incision, although it cannot be said to be as reliable as the latter, the eye being much more trustworthy than the hand. These remarks apply equally to the two following conditions, calculous disease and hydronephrosis.

(ii) *Calculous pyelitis or pyo-nephrosis* where the kidney is destroyed by long formation of calculi and consequent suppuration, where numerous calculi exist with sacculation of the kidney, or where a large and branching calculus is so embedded as to resist removal. These indications for nephrectomy have been already considered under the heading "Nephro-lithotomy" (p. 530), as it is during the performance of this operation that the question of removing the kidney for the above conditions will arise.

(iii) *A kidney the site of hydro-nephrosis or pyo-nephrosis in which the cause is irremovable*, or the kidney beyond hope of recovery.[2] The treatment here will vary according to the degree to which the disease has advanced. Aspiration, lumbar nephrotomy, and drainage, the edges of the cyst being stitched in the wound, and nephrectomy have each been advocated here. Occasionally repeated aspirations are sufficient, as in Mr. Croft's case,[3] in which eight aspirations (through the lumbar region) within four months, between three and four pints being withdrawn each time, sufficed to cure a hydro-nephrosis in a boy aged 12. It is noteworthy that the case was distinctly traumatic in origin, and that the last fluid withdrawn contained a very large amount of albumen. It is for such cases, especially if the interval between the aspirations lengthens each time, that aspiration should be reserved. In these cases the kidney often atrophies as a result of obstruction. Therefore the surgeon would be wise to explore the kidney and upper ureter, for in many cases he can save the kidney by a plastic operation. Failing this, drainage or nephrectomy has to be considered. It is now acknowledged by the advocates of the former step that it has given less favourable results than were expected. The time taken is usually very great, the frequent change of dressing necessitated by the constant soakage is most irksome, and, later, the wearing of a lumbar urinal is most inconvenient, leading as it often does to an eczematous, raw area around the sinus. The sinus, moreover, is liable to become foul and to contain phosphatic material. The tube also, which leads into the urinal from the sinus, easily becomes blocked, and causes much discomfort from redistension of the cyst.

During the operation of nephrotomy the ureter must be carefully examined with the view of discovering any removable obstruction in the form of a kink, valve, stricture, or a calculus placed low down. A

[1] *Ann. of Surg.*, March 1906, p. 418.
[2] Barling, *loc. cit.*
[3] *Clin. Soc. Trans.*, vol. xiv. p. 107.

ureteral catheter should be passed as far as the bladder to make certain that the tube is patent.

In future, nephrectomy will be oftener performed for hydro-nephrosis where the kidney is much altered, either as a primary operation or after allowing a sufficient interval to elapse for shrinking of a large cyst, but no prolonged delay. Where, therefore, the patients are young, with every prospect of a long and active life before them, where a month's drainage has failed to bring about any considerable diminution in the amount escaping, and where the fluid thus coming away contains but a small amount of urine, and where there is evidence that the other kidney is competent, the cyst and remaining kidney tissue should be extirpated from the loin before it has become more firmly matted to the surrounding parts.[1]

A papilloma of the renal pelvis may cause a large hydro-nephrosis with destruction of the renal tissue. Dr. Reynolds [2] describes such a case requiring nephrectomy. Albarran and Imbert were only able to collect accounts of twenty-two cases. It is possible that early diagnosis may enable the surgeon to save the kidney by removing the growth only, but it should not be forgotten that these growths are very liable to become malignant.

In cases where the hydro-nephrosis is early and due to movable kidney nephrorraphy will often suffice. In a few other cases the hydro-nephrosis may be due to valve or stricture of the ureter. For an account of the different operations performed for the relief of these conditions, I may refer my reader to the surgery of the ureter (p. 586).

(iv) *Certain cases of malignant disease.* These fall into two groups, which must be looked at separately from an operative point of view. (*a*) *Sarcoma* occurs in children before 10, usually much earlier, before 5. In such cases the risks of immediate death from shock, of early recurrence, or of death from secondary deposits elsewhere, should be put clearly before the parents, together with the certainty of an early death if the growth is left.

(*b*) *Carcinoma* occurs usually in patients past middle age.

In either case an operation should only be performed in an early stage, while the growth is still internal to the capsule, and while the strength, health, and condition of the viscera are satisfactory. On the other hand, where the history makes it probable that the growth has got beyond the earlier stage, when there is any extension to the lumbar glands or other viscera, when there is nausea, emaciation, hæmoptysis or a temperature inclined to fall, the time for operation has gone by. So, too, any ascites or œdema of the lower limb are absolute contra-indications. Varicocele is so uncertain a symptom, that it cannot be held to contra-indicate operation.[3]

With regard to the frequency of secondary deposits, the fact that Dr. Dickinson [4] found these to be present in no fewer than 15 out of 19 cases strengthens, very decisively, the argument in favour of early operations while these growths are small, at which time, moreover, they can be successfully attacked through a lumbar incision sufficiently enlarged by the steps given at p. 523, or by one made anteriorly.

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[1] If in hydro-nephrosis, after an exploratory nephrotomy, bloody urine or injected pigment descends into the bladder, the indication for leaving the kidney will be greater, especially if the viscus show a cortex of fair thickness, and is not a mere sac with little, if any, secreting tissue.

[2] *Ann. of Surg.*, 1904, vol. xxxix, p. 743.

[3] Richards, *Guy's Hospital Reports*, vol. lix.

[4] *Diseases of the Kidney and Urinary Derangements.*

Much information may be gained from a very complete study of sarcoma of the kidney in children by Mr. George Walker, of Baltimore.[1] In all, 74 cases in children in which nephrectomy was performed are here collected.   Of these 27 died from the effects of the operation, 28 died from recurrence, 14 passed out of sight, and 4 remained well from three to five years after the operation.   The immediate mortality is therefore 36·4 per cent.   Though still very high, this is a vast improvement on the earlier published figures ; for instance, Butlin[2] gives 60 per cent.   As regards cures, 4 cases, or 5·4 per cent., may be considered as probable cures, but it is quite possible that some of the 14 cases that passed out of sight were cured, since they were all of them well when last heard of ; in this case, 5·4 per cent. is too low.   Since the publication of this paper one of the supposed " cures " died of recurrence or of independent and similar disease in the other kidney, and 2 incomplete cases have been reported to be well after six and ten years respectively.   So that the proportion of cures may now be said to be at least 6·7 per cent.   Briefly, the most important points in conection with four of these successful cases are as follows :

1. *Israel's case.*   Boy aged 14 years.   The tumour, about double the size of a man's fist, was removed through a ⊤-shaped lumbar incision.   The perirenal fatty tissue was freely excised after removal of the growth.   Well five years later.
2. *Schmidt's case.*   Girl aged 6 months.   The tumour was the size of a child's head, and was removed through an incision two fingers' breadth to the left of the middle line of the abdomen.   The peritoneum was not sutured.   The child was well four years later.
3. *Abbe's case.*   Girl aged 2 years.   The tumour, which weighed 2½ lbs., was removed through a transverse incision extending from the lumbar region to near the middle line of the abdomen.   The child was well four years after, but she died of sarcoma of the other kidney nine months later.
4. *Abbe's case.*   Girl 14 months old.   A transverse incision was again used, extending from the middle line of the abdomen to within 6 cm. of the spine.   The child weighed 15 lbs., the tumour 7½ lbs.   The child was well three and a half years later.

Another successful case is described by Malcolm,[3] the child being in good health two years and four months after the operation.

Morris[4] concludes that the mortality from the operation has been reduced to between 20 and 25 per cent., and thinks that it is not likely to fall much lower than this.

Heresco[5] in his 53 cases in infants operated upon since 1890, found a mortality of only 17 per cent.

Ultimate Results.   Over 10 per cent. of the adult cases " were ' cured ' in the sense that they were known to be well at the end of three years, and are not known to have had recurrence since," although the results are less favourable in children, about 7 per cent. of " cures " occurring (Owen Richards).

Mr. Walker also compares the length of life, from the time of the discovery of the tumour, in cases not operated on with those that were operated on.   In 68 cases not operated on the average length of life was 8·08 months ; in the operation cases the average was 16·77 months, an average gain, that is, of 8·69 months by operation.

Since this disease, when left to itself, is necessarily always fatal, a rate

[1] *Ann. of Surg.*, vol. ii, 1897, p. 529 *et seq.*
[2] *Oper. Surg. of Malig. Disease*, p. 254.
[3] *Clin. Soc. Trans.*, vols. xxvii and xxviii.
[4] Vol. i, p. 603.
[5] *Thesis*, Paris, 1899, and quoted by Owen Richards in an excellent paper in the *Guy's Hospital Reports*, vol. lix.

of cure after operation of nearly 10 per cent. constitutes very strong evidence in favour of operation wherever there is a reasonable hope that the whole of the disease can be removed.

With earlier diagnosis and improved technique, it is to be hoped that a still greater measure of success will obtain.

To secure this improvement the following points deserve attention. An exploratory incision should be made as soon as obstinate pain and swelling (perhaps revealed by an anæsthetic), or free and recurrent bleeding shown to come from one kidney by means of the separator or the cystoscope or both, call attention to the possibility of a growth, and before time has elapsed for lymphatic infection. Where the case comes before the surgeon in a more advanced stage, he should bear Mr. Malcolm's advice in mind. As in the "treatment of new growths elsewhere, the more definite the outline of the tumour, the more mobile it is, the slower its growth, the better the state of the patient's health —in fact, the stronger the evidence that the patient is only locally affected, the more likely is operative treatment to be followed by prolonged immunity from disease." Cases may be observed, on the other hand, in which the tumour has no definite outline, being fixed to and incorporated with the neighbouring structures, so as to be absolutely immobile, being also of very rapid growth and accompanied by extreme emaciation. Such cases are obviously unsuitable for surgical interference. "Before the operation every precaution should be taken against shock. Thus the limbs should previously be bandaged in cotton wool, the site of the wound only exposed, the head kept low, injections of pituitary extract should be ready, ether administered, and warmth maintained during and after the operation. Finally, an assistant should always be at hand to perform saline infusion, and this, if used, should be resorted to before the close of the operation, when the condition of shock may be irremediable." [1]

During the operation itself the incision must be sufficiently free. The lumbar one, carried very freely forward [2] (p. 523), will give sufficient room for all except large tumours. The peritoneum will only be opened when the growth is very large or adherent. Finally, as Mr. Malcolm has shown, every vestige of the capsule, and all fat adjacent to it, together with any fat or glands about the renal vessels, should be removed.

The removal of renal growths through an anterior trans-peritoneal route used to be attended by about twice the mortality of the lumbar operation. This was chiefly due to greater risk of sepsis, but also to the fact that this method was used particularly for very large growths, considered to be too big to be removed through the loin.

In later cases, as shown by Heresco,[3] there has been very little difference in the mortalities of the two methods.

Morris strongly advocates a combination of the lumbar and lateral trans-peritoneal methods for malignant tumours of the kidney. He first explores through the linea semilunaris and examines the connections of the tumour; then, after temporarily closing this incision, he enucleates the kidney through the usual incision in the loin. The original wound is then reopened and the peritoneum raised from the

[1] Dr. Abbe strongly advises the use of the Trendelenberg's position as emptying the blood from the growth into more important parts, and the injection of strong coffee and brandy into the rectum after the operation.

[2] Dr. Abbe used a similar one in his two successful cases mentioned above.

[3] *Loc. cit.*

tumour, the pedicle secured, and the growth pushed and delivered through the anterior incision.

It is claimed that this method enables the surgeon thoroughly to explore the tumour and to determine the presence or absence of early secondary growths in the peritoneum and abdominal viscera before beginning the enucleation; also that the risk of injury of the great vessels is less than if either an anterior or posterior incision is used alone; that the delivery of the tumour forwards is facilitated by a hand in the posterior wound. Moreover, the lumbar wound is the best for drainage.

(v) *Certain cases of injury.* These are very rare, and fall into the following groups: (a) Where an injured kidney protrudes from a wound of the abdomen, usually the loin. (b) In some cases of non-penetrating wound of the kidney, as when it is ruptured from a fall or blow. (1) Where hæmaturia does not yield to treatment,[1] the bleeding being well marked, or latent and insidious, giving evidence indirectly of its existence by the increasing pallor, the failing pulse, impending syncope, and perhaps a swelling in the loin. (2) Later on, when the injured kidney is setting up serious suppuration, which does not yield to drainage. (3) For ruptured ureter and traumatic hydro-nephrosis. Mr. Barker has recorded [2] a most successful case, in which, after other treatment had failed, he removed a kidney three months after the rupture.

The child, aged $3\frac{1}{2}$, had been run over, but beyond some bruising and one small clot passed there was nothing to point to injury of the urinary tract. Having left the hospital in a fortnight, apparently convalescent, he was, a few days later, admitted with a fluctuating swelling in the right loin. This increasing, was aspirated, the fluid yielding $\frac{1}{2}$ per cent. of urea. The swelling was subsequently drained, and the drainage-tube becoming blocked with phosphatic deposits, and thus causing a good deal of constitutional disturbance, the kidney was removed. It proved to be healthy, the ureter being torn across just below it.

At the present time, if this condition be discovered at an exploration for traumatic hydro-nephrosis, it may be found possible to save the kidney by performing a plastic operation on the ureter. The author has successfully sutured the ureter in such a case. Tilden Brown, however, failed to discover a rent in the ureter until suppurative nephritis had developed, and he was forced to remove the kidney about seven weeks after the injury.[3] When the ureter is accidentally divided during a pelvic operation, if the calamity is discovered at once immediate anastomosis should be performed. If this fails, and suppurative nephritis and a fistula follow, then nephrectomy may become necessary.

(c) Penetrating wounds. Very rarely indeed nephrectomy may be called for here (1) when hæmorrhage does not yield to treatment aided by exploration and plugging; (2) when a urinary fistula persists after such a wound in certain cases, *e.g.* when the other kidney is healthy. (d) Gunshot wounds. Whether in civil or military practice, gunshot wounds of the kidney are only too likely to be complicated with injuries of the intestines, liver, and spine. When, in the course of an exploratory operation in the case of a gunshot wound of the abdomen, the kidney is found to be the seat of hæmorrhage, if uncontrollable by other means, nephrectomy should be performed.

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[1] In Mr. Rawdon's case (*loc. infra cit.*) nephrectomy was performed for hæmorrhage after an injury, but at rather a later date, *e.g.* on the seventeenth day after the fall, to prevent blood from entering the bladder and increasing the acute cystitis present. Here the hæmaturia had diminished at first, and subsequently increased.

[2] *Lancet,* January 17, 1885.   [3] *Ann. of Surg.,* 1905, vol. xli.

(vi) *For a few rare diseases of the ureter.* Another very instructive case, one of ureteral papillomata, is described by Le Dentu and Albarran : [1]

Male, 33, had had frequent attacks of renal colic for which nephrotomy had been performed without benefit. A diagnosis of ureteral papilloma was arrived at by means of the cystoscope. The kidney and ureter were therefore removed. The kidney was hydro-nephrotic, and the ureter contained two papillomata, one three-quarters of an inch below the renal pelvis, the other at the vesical orifice.

(vii) *Hydatid disease of the kidney.* Jerosch [2] has recorded two cases of nephrectomy for this rare condition. In the first case, death took place on the third day from exhaustion ; the second case recovered.

The results of nephrectomy for hydatid disease have been poor, but in several instances this was due to excision of the only kidney,[3] a mistake which should be avoidable at the present day by adopting the methods of thorough examination advocated at p. 512.

Morris points out that the structure of the kidney may not be seriously affected by hydatid disease, and that nephrotomy is therefore more suitable than nephrectomy, which should only be adopted when there is " suppuration of the kidney, or rupture of the hydatid cyst into the lung or peritoneum." Secondary nephrectomy may be found to be required if nephrotomy and drainage, or excision of the cyst, fail to cure the disease.

(viii) *Cystic disease.* Surgical interference for polycystic disease of the kidney has been generally considered to be unwise, because of the frequency of bilateral disease, and the belief that the second kidney may rapidly develop the same disease after the removal of the first. There are *exceptional cases*, however, in which nephrectomy is called for. These are cases in which the disease has been proved to be unilateral, and the symptoms are grave from rapid growth and increasing distension, and especially when repeated and profuse hæmaturia occurs.

Morris performed nephrectomy in four cases. Two of the patients were well three and seven years later, one died of similar disease in the other kidney four months later, and the other died on the second day from suffocation due to vomiting.

Morris [4] advocates his combined operation, with examination of the other kidney, by palpation, which he considers satisfactory in these cases, any enlargement being easily detected. When the condition is discovered for the first time during a lumbar exploration, the other kidney should be explored through the loin, or through the anterior end of the wound already made,[5] before proceeding to excise the diseased kidney. This course may not be always necessary, for the cystoscope, the segregator, and estimation of the urea, may have afforded ample evidence of the condition of the other kidney. It may be easy to tell that the kidney which is displayed in the wound is so diseased that it can take very little or no part in the excretion. In two cases known to me at Guy's Hospital, it was considered to be unnecessary to explore the opposite kidney for these reasons. Both of them did well. The first had repeated and severe attacks of unilateral hæmaturia, which was thought to be due to malignant growth ; the other was diagnosed as a tuberculous pyo-nephrosis. The temperature was intermittent and pain severe. Ten years later this

[1] *Bull. de l'Acad. de Méd.*, No. 9, 1899.
[2] *Centralbl. f. Chir.*, No. 38, 1899.
[3] Houzel, quoted by Morris, vol. i, p. 681.
[4] Vol. i, p. 66.   [5] Barling, *loc. cit.*

patient came to me with a large cystic kidney on the other side. The urine was albuminous and the patient suffering from chronic uræmia. It must not be forgotten that a large cystic kidney may not be palpable through the parietes. Dr. Bevan [1] removed a large polycystic kidney which he discovered during an exploration for hæmaturia with severe pain on one side. The condition of the other kidney was not known, but the patient recovered and was well a year later. Dr. Parker Syms [2] was unable to discover any enlargement of one kidney in a very thin woman with flaccid abdomen, and he therefore judged that it was not enlarged; therefore when the other kidney, which was greatly enlarged, was proved to be cystic on exploration, it was removed. The patient was quite well a fortnight later. It is needless to say that the after-history is too short. Dr. Haynes [3] candidly reported the removal of one of two cystic kidneys, the patient dying uræmic a fortnight later.

(ix) *Aneurysm of the renal artery.* Prof. W. W. Keen [4] reports a successful case of nephrectomy for this rare form of aneurysm :

The patient was a lady, aged 45, who had suffered for about five years from severe attacks which began with chilly sensations, followed by nausea and considerable rises of temperature. These attacks lasted a variable time and were thought to be " bilious." Once only, during the last attack, there was a small amount of blood in the urine. A large tumour, thought to be probably a hydro-nephrosis, was found occupying the whole right ilio-costal space, and extending from the right flank to a point about 5 cm. beyond the middle line. The tumour, which was removed without great difficulty, was found to consist of the kidney flattened out on the surface of a large aneurysm of a branch of the right renal artery.

Prof. Keen gives abstracts of twelve similar cases, two of which were operated on. Recovery took place in both these. Prof. Keen remarks that " there is nothing peculiar about any of the three operations other than the danger of hæmorrhage, especially from the pedicle. In my own case the pedicle was broader than I have ever encountered in any prior case of nephrectomy, so that I had to tie it in seven different sections. All three of the operative cases have terminated in recovery, a most encouraging outlook for the future."

Operations. These are: A. **Through the Lumbar Region.** B. **Through the Abdominal Wall, and the Peritoneum as well**—(a) by an incision at the outer edge of the rectus; (b) by one in the linea alba. C. **Through the Abdominal Wall without opening the Peritoneum.** These methods are compared at p. 555. D. **A Combination of the Abdominal and Lumbar Incisions.** E. **Morris's Combined Method.** F. **Knowsley Thornton's Combined Method.**

A. **Lumbar Nephrectomy.**

Operation. The position [5] of the patient and the earlier steps are much as those already given in the account of nephro-lithotomy, p. 523.

When the lumbar fascia has been slit up and the fat around the kidney incised, this organ should be well thrust up by an assistant making careful, steady pressure with his fist against the abdominal wall; the wound being now widely dilated with retractors, the surgeon examines the kidney, and has next to decide on three points: (1) Is

[1] *Ann. of Surg.*, 1906, vol. xxxix, p. 467.
[2] *Loc. cit.*, p. 598.
[3] *Loc. cit.*, p. 599.
[4] *Philad. Med. Journ.*, May 5, 1900.
[5] Additional care should be taken to open out the space between the last rib and the crest of the ilium by the arrangement of pillows underneath the loin; the precautions given to avoid shock (p. 544) must also be taken here.

removal required ? [1] (2) Will more room be wanted ? · If so, the incision already made, slightly oblique and about half an inch below the twelfth rib, should either be converted into a T-shaped one by another made downwards from its centre, or at its posterior extremity, along the outer edge of the quadratus lumborum, or continued downwards and forwards, as described under " Nephro-lithotomy " (see p. 523). Additional room may also be gained by an assistant slipping his fingers under the lower ribs and drawing them forcibly upwards. (3) Is the kidney firmly matted down or no ? If there has been no surrounding inflammation, the extra-peritoneal fat, the peritoneum and colon will be readily separated by the finger working close to the kidney until the pelvis and vessels are reached. But if inflammation has caused firm adhesion and matting down of the kidney to adjacent parts, the altered fat and thickened and adherent capsule must be divided down to the kidney itself, and this gradually enucleated with the finger, from out of its capsule, which is left behind. This method is not to be recommended unless it is absolutely necessary, because disease may be left behind, troublesome fistula may persist, or a hæmatoma may form within the rigid walls of the cavity.[2]

The only guide in such a case is the tissue of the kidney itself, close to which the finger must be kept.

Mr. Greig Smith stated [3] that, in cases of old-standing suppuration with great enlargement, the vena cava and the aorta may be intimately adherent to the capsule. " One such case was met with in the post-mortem room of the Bristol Infirmary ; here it was simply impossible, after death, to dissect apart the venous wall and the renal capsule. In another case, for similar reasons, the organ could not have been removed by any proceeding claiming to be recognised as surgical."

If further room is still required, this may be easily and effectually gained by making use of additional incisions, as recommended under " Nephro-lithotomy," or by adopting the method advocated by Prof. König, of Göttingen.[4] This surgeon, having found great difficulty in getting free access to the kidney by the ordinary lumbar incision, cuts through the soft parts vertically downwards along the border of the erector spinæ to just above the iliac crest. He then curves the incision towards the navel, and ends at about the outer border of the rectus, if necessary going through this muscle to the umbilicus. It may be often advisable to make the first cut oblique, running in a flat curve into the umbilical part. All the muscles are incised quite down to the peritoneum. This method gives a surprisingly free entrance, but it can be much improved by introducing the hand through the perpendicular part of the cut, separating the peritoneum in front and pushing it forwards. Prof. König proposes to call this the retro-peritoneal lumbo-abdominal incision. If sufficient space is not thus afforded, or if, for diagnostic or operative purposes, it is desirable to approach the tumour from the abdominal cavity, the peritoneum can be divided in the transverse cut. If infective material is to be removed, this peritoneal opening must be carefully looked after. The need of free division of muscular fibres, involving undue liability of ventral hernia, is a serious objection to adopting König's incision.

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[1] This question has already been alluded to in the case of a tuberculous kidney incised and drained (p. 512); in that of a kidney much damaged by one or more calculi, under the subject of nephro-lithotomy (p. 530) ; and in the case of hydro-nephrosis (p. 541).

[2] Morris, *Lancet*, January 1, 1898.   [3] *Abdom. Surg.*, p. 508.

[4] *Cent. f. Chir.*, 1886, Hft. 35 ; *Ann. of Surg.*, November 1886, p. 445.

Very large kidneys and renal tumours can be got out through very free lumbar incisions. Mr. Jacobson twice, in 1890, removed kidneys eight inches long through the very limited ilio-costal space of little children aged respectively 3 and 3½. One was a case of sarcoma, the other of cystic kidney. Both made excellent recoveries; but as in the former the renal vein was thrombosed with growth, it was clear that a few months would see the end. In each case the lumbar incision was carried forward very freely, and the long axis of the tumour brought out in that of the wound.

In both Abbé's successful cases of sarcoma (*vide supra*, p. 543) long transverse lumbar incisions were found to give ample room, in the second case the tumour weighing 7½ lbs. in a child only 14 months old. Many other cases might be quoted.

The danger of ventral hernia is guarded against by using deep sutures, by allowing only gentle movements at first when the patient gets up, and by the use of a support. By these means the risk of hernia may be reduced to a minimum.

When the kidney has been sufficiently enucleated either out of its capsule, or, together with this, out of the perirenal fat, the vessels and ureter must be dealt with.

The vessels are tied with a long piece of strong catgut used as a Staffordshire knot. This is passed, with an aneurysm-needle of sufficient length and suitable curve, through the centre of the pedicle, after the latter has been crushed with strong forceps to diminish its bulk and make a groove for the ligature. The ligature should be pushed well in towards the spine, so as to leave ample room between it and the kidney to prevent all risk of slipping. If the kidney can be raised out of the wound, passing the ligature is much simplified. If this is impossible, the surgeon may find help by having the lower ribs well pulled up by an assistant, while another keeps the kidney well up, light being also thrown in, in case of need, by a forehead mirror or electric lamp. While the ligature is tied and the pedicle divided, no tension should be put upon the vessels. If in doubt, an additional ligature should be tied round the pedicle (*see* Fig. 233).

As soon as the ligatures are secured in position, the pedicle is snipped through at a safe distance from them with blunt-pointed scissors. If any hæmorrhage now takes place, it is probably due to some vessel [1] not being included, or to an artery having slipped through the knot owing to the parts being stretched at the moment of ligature. The bleeding-point is now secured with forceps and ligatured. Traction must not be made upon the ligatures, which may slip or tear off a friable pedicle with disastrous results. To avoid the pedicle slipping away out of sight as it is divided, a pair of artery forceps are always applied to it from below, deep to the ligature.

When a pedicle presents especial difficulties from its shortness, thick-

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[1] The late Mr. Greig Smith (*loc. supra cit.*) gave the following practical hints as to the vessels: The veins are a good deal larger than the arteries, and overlap them. At the hilum the veins branch quite as much as the arteries, *i.e.* four or five times, and the subdivision extends farther towards the middle line. It is very frequent for two or more trunks to represent the renal vein, and sometimes surround the artery. The want of uniformity in the renal vessels is against the possibility of ligaturing the artery and vein separately. In many cases this will be found impossible; in none is it necessary. Indeed, the walls of the veins, by acting as a sort of padding, may add to the safety of ligatures, preventing the thread from slipping. Mr. Greig Smith further states that the only deaths as yet recorded from secondary hæmorrhage were in two cases where the vessels were separately tied.

ness, and the way in which it is overlapped by the kidney, a strong clamp should be applied and the kidney cut away well in front of it, a step which will give access to the vessels and ureter ; a strong ligature is then applied behind the clamp, which is now removed.

Again, where the pedicle is very short, a portion of kidney may be left to ensure the ligature retaining a safe hold. I was obliged to adopt
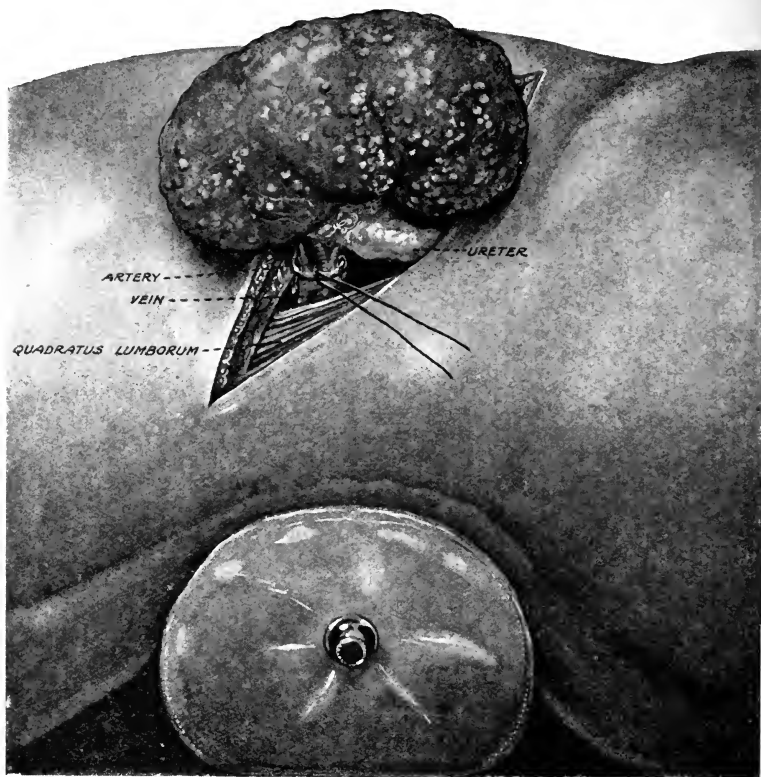
FIG. 233. Nephrectomy for tuberculosis of the kidney. The vessels are tied with strong catgut. The diseased ureter also is removed.

this course in a case of nephrectomy for calculous pyelitis in which I had removed twelve stones a year before. A sinus persisted, which became abominably septic. As the stump of the kidney was fœtid, I inserted no sutures, and packed the wound with strips of antiseptic gauze. The patient made a good recovery. In such a case when we know the other kidney to be healthy primary nephrectomy is indicated.

A modification of the method of leaving a portion of the kidney to form the pedicle may be made use of in cases of kidneys of large size which cannot be brought through the wound. In such cases, the vessels having been secured by a temporary ligature or by forceps, the kidney should be cut away in separate portions, thus doing away with the struggle required in bringing out a large kidney and the risks of tearing the vessels and of producing serious shock by pulling on the pedicle.

Another means of treating the pedicle, where this is short and matted

down, is to cut it through piece by piece, securing each bleeding-point with compression forceps, and tying them off one by one.

By such methods as the above the risk of wounding the cava or aorta is avoided. If the amount of kidney left is small, it will no doubt atrophy and give no further trouble, but if large, some sloughing will probably take place.

Another difficulty which may be present now is caused by the kidney having contracted adhesions to the peritoneum and some of its contents.

Mr. Jacobson three times opened the peritoneum without ill effect when using the lumbar incision.

The question may arise as to what is to be done if hæmorrhage still persists after the kidney is got out and its pedicle tied. Very few cases will occur in which ligatures cannot be applied to each bleeding-point if the wound be well opened up, carefully dried, and if light be thrown down to the bottom. But when bleeding still goes on, artery forceps must be applied to the bleeding-point and left *in situ* for two or three days, during which time they will also help to drain the wound. Mr. Jacobson used this method twice with good results. If the forceps will not hold, careful plugging must be resorted to; rolls of aseptic gauze wrung out $\frac{1}{20}$ carbolic are carefully packed into the bottom of the wound and around the pedicle. One end of each roll is secured to the lips of the wound. When the cavity has been tightly packed, an external gauze and wool dressing is applied and firmly bandaged.

When all bleeding is stopped, a large drainage-tube should be inserted, at the posterior angle of the wound. The wound is then partially closed with catgut and salmon-gut sutures, and aseptic dressings applied. If there has been much difficulty in getting out the kidney—and in cases of old inflammation it has to be dug out by touch, with very little help from sight—few sutures should be used, the wound being lightly plugged with gauze wrung out of carbolic acid lotion 1 in 20.

Dr. Weir, of New York,[1] during a nephrectomy in a young woman the subject of pyo-nephrosis, met with very severe hæmorrhage after ligature of the pedicle. This had apparently been effected with a single ligature. After removing the kidney, a gush of venous blood ensued, which was only partly arrested after repeated seizures with long pressure-forceps, but was finally controlled by stuffing the wound full of sponges and turning the patient on her back. The shock was profound, and all the measures to produce reaction were resorted to. Transfusion performed twice to a total amount of 22 oz. gave rise at first to great improvement, but the patient died ten hours after the operation. The necropsy showed that the hæmorrhage came from a vein of considerable size, 1·5 centimetre above those secured by the ligature and forceps.

If the ureter be dilated, and contain pus or tubercular matter, it should be tied with catgut and divided below the disease if possible; if not, the stump should be cauterised with strong carbolic acid. Whenever possible the diseased ureter should be removed with the kidney, its lower extremity having been clamped to prevent infection of the wound.

Ramsay [2] discusses the mode of dealing with the ureter in tuberculous cases at some length, and quotes Regnier as having removed a tuberculous ureter some months after the nephrectomy. Kelly, in the *Johns Hopkins Bulletin*, March 1896, reports three cases in which he removed the whole of the tuberculous ureter with success at the time of the nephrectomy. On the other hand, there is evidence to show that tuberculous disease of the ureter tends to undergo a process of cure after nephrectomy. One

[1] *Ann. of Surg.*, April 1885, p. 311.　　　　[2] *Loc. supra cit.*

case in point is that of Tilden Brown.[1] Here the kidney was removed and the ureter left behind. At the necropsy, some months later, the ureter, previously as thick as the thumb, had diminished to one fourth its size.

Ramsay's conclusions on this point are as follows : " It is safest to remove the ureter with the kidney, as a persistent fistula may give trouble if it is allowed to remain in the body ; " and again, " that a certain proportion of these fistulæ will finally disappear, either after the removal of a deep suture, or because of the slow disappearance of the tubercular disease in the ureter, which, in these cases, gradually changes into a fibrous cord."

When the condition of the patient allows the author always removes all the ureter that is diseased. In some cases this can be easily done from the loin. In others the extent of the disease makes it necessary to divide and cauterise the diseased ureter in the loin, and when the posterior wound has been closed and the patient turned on his back, an incision is made in the corresponding linea semilunaris. The rectus and parietal peritoneum are displaced inwards, the ureter found by blunt dissection in the extra-peritoneal tissues, gradually separated from its connections as far as the bladder, close to which it is tied and divided between the ligature, and a clamp placed a little above the ligature to act as a tractor for the application of the ligature and to prevent leakage of tuberculous material into the wound. The parietal incision is then closed in layers and is less likely to be followed by hernia than when the oblique muscles are cut across as some surgeons suggest.

B. Nephrectomy by Abdominal Incision through the Peritoneum.

(a) **By Langenbüch's Incision at the Outer Edge of the Rectus.**

(b) **By an Incision in the Linea Alba.**

These two methods may be taken together. The former is the one most usually employed, as it has the following great advantages :

(1) The incision is nearer the vessels and ureter. (2) There is much less general exposure of the peritoneal sac. (3) The kidney is reached through the outer or posterior layer of the meso-colon, a step which avoids (a) hæmorrhage and (b) the risk of sloughing of the colon, as it is the inner or anterior layer—that between the colon and the middle line—which contains nearly all the vessels to the colon, and is especially rich in veins. (4) The operation can be rendered largely extra-peritoneal by having the inner edge of the cut meso-colon and that of the parietal peritoneum held in apposition or sutured with catgut.

Both operations give good room for necessary manipulations, both afford an opportunity for examining with the hand the condition of the opposite kidney.[2] After both, the wound can be drained posteriorly from the loin, but more easily after Langenbüch's incision.

[1] *Ann. of Surg.*, 1899, vol. i, p. 755.

[2] I think this advantage of the incisions through the peritoneum has been made too much of. In Mr. Barker's words (*Dict. of Surg.*, vol. ii, p. 48), " Though the hand may reach the kidney opposite to the one it is proposed to excise, its soundness or the reverse cannot be ascertained by mere palpation. Great enlargement, or, on the other hand, great reduction, in size, or complete absence, might be detected ; but the organ might be tubercular, or fibroid, or contain a moderate-sized calculus, and yet the hand be unable to detect the condition." I have also referred to this matter, p. 536. Morris (*Diseases of the Kidney and Ureter*, 1901, vol. ii, p. 269) records an interesting case in which the opposite mistake was made. A surgeon, exploring through the right linea semilunaris, discovered what he thought to be a renal sarcoma. With his hand in the abdominal cavity he could not discover the left kidney, and he therefore concluded that the condition was hopeless. Later Morris was able to feel the left kidney by bimanual examination. The growth, which was successfully removed, was an ovarian dermoid.

(a) **Langenbüch's Incision.** An incision is made, at least four inches long at first, commencing just below the ribs, in the line of the linea semilunaris on the side of the disease, the centre of the incision being usually opposite the umbilicus.   The skin, subcutaneous tissue, and the aponeuroses at the outer edge of the rectus having been divided down to the transversalis fascia, and all hæmorrhage having been carefully arrested, the transversalis fascia and the peritoneum are pinched up together, punctured, and slit up on a finger used as a director, the hand is introduced, and the size of the growth and the condition of the opposite kidney investigated.   In the case of a large growth the incision will now be enlarged, and any further hæmorrhage arrested.   The growth, if large, is usually now seen in part.   Any presenting intestine is turned over to the opposite side, and kept out of the way with a large pad of aseptic gauze.   The outer or posterior layer of the meso-colon will now probably present itself, pushed forward by the growth, which is often bluish-white in appearance and covered by large veins.   This layer of the meso-colon is next nicked and torn through, either in a vertical or transverse direction, as will best avoid the vessels exposed.   Any bleeding should be at once arrested by forceps and ligatures of fine silk.   The intestines are then packed away with sterile gauze.

A sufficient opening having been made in the outer layer of the meso-colon, the fingers are introduced to examine into and further separate the connections of the kidney.

During all the necessary manipulations in the case of a growth, the greatest possible gentleness must be used so as not to rupture the capsule. In rapidly growing sarcomata, especially in children, the consistency may be jelly- or glue-like, and thus, if the capsule is opened, portions of the growth may readily be left behind.   Again, hæmorrhage may easily follow this accident, and prove most embarrassing.[1]

The same precautions as to not damaging the capsule should be taken in the case of a kidney full of fluid.   Where there is any risk of such fluid or of soft growth escaping into the peritoneal sac, sterile gauze should be carefully packed around, or the cut edges of the meso-colon and the parietal peritoneum united (*see* Fig. 234).

If the parts about the pedicle are free from adhesions, the vessels may be tied before the kidney is enucleated, which will render this latter step bloodless.   Wherever it is possible, forceps should be placed on the vessels close to the kidney before they are divided, to save spilling of blood from the kidney ; and where this contains pus, the same precaution should be taken with the ureter.

The vessels should be tied with the precautions given above (p. 549). All dragging on the pedicle should be scrupulously avoided.

The kidney being removed, the site of the operation is most carefully cleansed and dried.   If troublesome oozing has occurred and is at all likely to persist, a large drainage-tube is passed out through the loin by pushing a short pair of dressing-forceps from the site of the kidney so that it bulges in the loin, where it is cut down upon, and

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[1] Thus it has even happened to Prof. Czerny, whose experience in nephrectomy is almost unrivalled, to be driven to tie the abdominal aorta.   The profuse hæmorrhage met with in removing a large growth of the left kidney could only be stopped by pressure on the abdominal aorta.   This vessel was accordingly tied.   Death took place ten hours later. It was found that the renal artery had been torn through at its entrance into the tumour. The ligature on the aorta had been so placed that, while the blood-supply through the left was cut off, the right vessel was pervious.

used to seize the tube. It has been suggested that the divided edges of the meso-colon may be united with a few points of catgut suture, but this precaution does not seem to be absolutely needful, as the edges usually fall readily into apposition. The parietal wound is closed in layers.

(*b*) **Nephrectomy by an Incision in the Linea Alba.** For reasons

Fig. 234. Transperitoneal nephrectomy for growth. The parietal peritoneum has been divided external to the colon and the latter has been drawn inwards with its vessels, to expose the pedicle of the kidney.

already given, p. 552, this method is not recommended, that of Langenbüch, already fully described, being preferable.

The incision near the linea alba will not materially differ from that for abdominal exploration, chap. i, and the same precautions are called for in removing a kidney by this method as in that through the linea semilunaris.

C. **Nephrectomy through the Abdominal Wall, but without opening the Peritoneum.** Having made use of the method in one case Mr. Jacobson was much struck by the room afforded.

The patient was a woman, aged 54, the subject of a movable kidney on the right side, the kidney being also the seat of malignant disease. As the abdominal walls

were thin, and as the kidney could easily be made to project in the anterior part of the right lumbar region, he made a longitudinal incision from the anterior superior spine up to the eighth rib. The different layers were cut through, very little hæmorrhage being met with ; when the peritoneum was reached, this was then stripped up out of the iliac fossa, upwards and inwards, then upwards off the anterior surface of the kidney until its vessels came in view. No difficulty was experienced in dealing with the pedicle—first the ureter, and then the vessels. The vena cava was seen for about an inch and a half receiving pulsation from the aorta. The patient never rallied thoroughly from the operation, and sank about twenty-four hours after. The necropsy showed ligatures firmly tied ; one of those on the renal vein had slightly puckered in the inner surface of the vena cava. A clot the size of the little finger constituted all the bleeding that had taken place. The kidney was, save for one small patch at the lower part, entirely converted into encephaloid carcinoma. Two or three of the aortic glands were enlarged ; there were no other secondary deposits.

Paterson [1] publishes an account of a similar operation and strongly recommends it ; his patient was well $4\frac{1}{2}$ years after the removal of a carcinomatous left kidney. To avoid the risk of a ventral hernia drainage, if required, is carried out through a stab wound in the loin, the anterior wound being accurately closed in layers.

D. **Combination of Lumbar and Abdominal Nephrectomy.** Dr. Hume, of Newcastle, made use of this method in a case of sarcoma : [2]

An incision about six inches long was first made in the linea semilunaris, and the swelling found to be in the left kidney. A lumbar incision was then made from the middle of the first cut, dividing all the structures forming the abdominal wall, including the peritoneum. The intestines were pushed to the right and protected with sponges. The peritoneum covering the kidney was then separated until the whole growth was exposed. The large cavity left was plugged with sublimate gauze dusted with iodoform, the ends of the strips being brought out through an opening in the most dependent part of the loin. The strips were removed in thirty-six hours. The patient recovered.

E. **Morris'** [3] **Combined Method** has been described briefly at p. 544 ; he recommends it for the removal of renal growths.

(a) **Choice between Lumbar and Abdominal Nephrectomy.** While it is certain that all kidneys of small or moderately large size can be easily removed by a lumbar incision sufficiently enlarged (p. 548), time alone will show whether I am right in my opinion that before the lumbar method is abandoned a trial should be made of such a free incision as König's (p. 548) when large kidneys have to be attacked. And this leads to the question of chief importance : How far is the danger really increased by going through the peritoneum to get at the kidney ? I am strongly of opinion that, in spite of all the improvements in abdominal surgery, the lumbar operation is the safest, especially when the kidney is septic or tuberculous, and it is also accompanied by less shock than the abdominal operation ; although the combined method of Morris is strongly indicated for large renal growths, especially to give more room in children.

Lumbar Nephrectomy—Advantages : (1) The peritoneum, save in cases of exceptional difficulty, is not opened or contaminated. (2) Efficient drainage is easily provided. (3) The structures interfered with are much less important. (4) As pointed out by the late Mr. Greig Smith, " in the case of its being unwise, as in abscess, or in tumour affecting the surrounding tissues, to proceed to removal, it is less serious to the patient." (5) If the kidney is firmly matted down, as in the cases given at p. 530, such dense posterior adhesions are most readily dealt with by the lumbar method. (6) The lumbar incision, if converted

[1] *Lancet,* 1903, vol. i, p. 729.   [2] *Ibid.,* 1893, vol. i, p. 196.
[3] *Surgical Diseases of the Kidney and Ureter,* vol. ii, p. 250.

into a **T**-shaped one, or prolonged forwards by König's method, will give sufficient room for meeting most of the conditions which call for nephrectomy. Thus modified, it will suffice for new growths.

Lumbar Nephrectomy—Disadvantages : (1) It is thought by some that too little room is given by this method for the removal of large kidneys. It has already been shown (p. 548) how extensively this incision can be enlarged. It is doubtful, therefore, if this objection holds good except for large renal growths, especially in children. (2) In a fat subject the organ may be difficult to reach, even when well pushed up from the front, owing to the great depth of the wound. (3) The pedicle is less easily reached,[1] and thus, in cases of difficulty, bleeding at a very important stage of the operation is less easily dealt with. (4) If the kidney be very adherent, important structures, *e.g.* the peritoneum and colon, may be opened, unless great care is taken. (5) The condition of the opposite kidney cannot be examined into. Possible fallacies here have been pointed out, p. 552, footnote.

Nephrectomy by Abdominal Incisions in the Linea Alba, or at the Edge of the Rectus, the Peritoneal Cavity being opened—Advantages : (1) Additional room in case of large kidneys. (2) More easy access to the pedicle, the vessels of which can be tied early in the operation to lessen hæmorrhage during enucleation ; this is, however, not always possible, for large growths may overlap the vessels, and in inflammatory cases, there may be much confusion from matting and adhesions. (3) The possibility of examining the condition of the other kidney. It has already been pointed out (pp. 536 and 552) that this advantage is probably overrated. Thorough examinations along the lines laid down at p. 512 are far more reliable, for a kidney which may seem to be normal to the touch, may be insufficient after the other is excised. (4) The extent, the presence or absence of secondary growths, and the wisdom or otherwise of attempting nephrectomy can be decided early in the operation. (5) The diagnosis can be made absolute between renal and other enlargements.

Nephrectomy by Abdominal Incisions through the Peritoneum— Disadvantages : (1) The peritoneal sac is opened. (2) The same sac may be seriously contaminated if a kidney containing septic matter, or one largely converted into soft growth, is ruptured during the needful manipulations. (3) The intestines may be difficult to deal with, and may, by crowding into the field of operation and the incision in the abdominal wall, prove most embarrassing. Peritoneal adhesions may follow, and lead to intestinal obstruction later on. (4) The handling and interference with the contents of the peritoneum may cause considerable shock. (5) The vitality of the colon may, by interference with its blood-supply, be endangered. (6) It is more difficult, by this method, to deal with any dense adhesions which may exist behind the kidney. (7) If bleeding follow the operation, reopening an abdominal wound, finding the bleeding-points and securing them, or plugging the wound, will be attended by more shock than the adoption of the same course by the lumbar method. A case supporting this view is candidly reported by Mr. Page, of Newcastle.[2] (8) Efficient drainage is less easily provided in cases of any contamination of the peritoneal cavity, or of oozing after the kidney is removed. (9) The after-complication of a

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[1] This objection and the next can be met by a very free incision (p. 548).
[2] *Lancet*, 1893, vol. ii, p. 1187.

ventral hernia is much more probable by this method, though it must be allowed that the free lumbar incision already alluded to may be followed by the same result.

Morris, with all his experience,[1] advocates the use of the lumbar operation for all cases except for tumours of very large size, injuries of the kidney which may be complicated by other injuries within the abdomen, and the rare cases in which a kidney really floats in the peritoneal cavity anchored only by its pedicle, which is surrounded by peritoneum. He states that "the lumbar operation ought not to be regarded merely as the operation of choice ; with the exceptions stated, it is the only operation which ought to be considered justifiable. The kidney as an extra-peritoneal organ ought to be attacked from behind, and not across the peritoneal cavity."

Causes of Death after Nephrectomy. (1) *Shock.* This may be induced by hæmorrhage, much traction on the pedicle, and thus, probably, interference with the solar plexus, injury to the colon, and, where the peritoneal sac is opened, by much disturbance of its contents. (2) *Hæmorrhage.* This is especially to be dreaded where the pedicle is deep and difficult to command ; where there are aberrant renal vessels ; where these vessels are enlarged and perhaps softened ; where, owing to too much tension on the pedicle, a vessel retracts from within its loop of ligature ; where the kidney capsule and tissue are broken into. In the intra-peritoneal method there is the additional danger of enlarged veins within the meso-colon. Secondary hæmorrhage has been alluded to above, pp. 531, 532. (3) *Uræmia and Anuria.* These are only likely to occur when it has been impossible to form a correct estimate of the condition of the opposite kidney, or where, to give a patient a chance, the surgeon operates in what he knows to be a doubtful case. Where there is reason to believe that the suppression of urine may be due to a calculus in the opposite kidney, this should at once be cut down upon in the hope of finding a calculus that can be removed. Mr. Lucas's brilliant example of what nephro-lithotomy may do, when such peril sets in at a later date, has been referred to at p. 536. (4) *Peritonitis.* This, if septic, is due either to mischief introduced at the operation or from the kidney. While it is certainly more likely to follow the intra-peritoneal operation, it may occur after that through the loin, especially when much difficulty is met with here, owing to numerous adhesions, or to working in a wound of insufficient size.[2] (5) *Septic trouble—Cellulitis—Pyæmia.* These are especially likely when the kidney contains septic matter, when the soft parts are much bruised. Other, rarer, causes of death are— (6) *Pulmonary Embolism.* (7) *Empyema.* This may be brought about by an extension of septic cellulitis, or by removing, during the operation, a portion of rib in order to get more room—a step the danger of which cannot be too strongly enforced (p. 530). An anatomical predisposition favouring the passage of inflammation from the kidney to the pleura has been pointed out by Dr. Lange, of New York. This authority on renal surgery found, in one subject, an enormous gap in the diaphragm, the muscle fibres being

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[1] *Loc. cit.*

[2] During a nephrectomy for pyonephrosis the peritoneum was injured owing to the adhesions of the renal capsule. As it was thought certain that some septic fluid had escaped into the peritoneal cavity, this was opened by a small incision above the pubes after the lumbar wound had been closed. Some ounces of bloody fluid escaped, the cavity was washed out, and a drainage-tube placed in Douglas's pouch. The patient recovered. (F. Page, *Lancet,* 1893, vol. i, p. 999.)

absent from the ligamentum arcuatum internum as far as the outermost part of the eleventh rib. Between these two points the fibres of the diaphragm communicated in a high arch, bounding an area in which the fatty tissue about the kidney was in direct contact with the pleura. (8) *Intestinal Obstruction.* This occurred fatally in one of Mr. Thornton's cases. He thought it was brought about by his suturing the two edges of the peritoneum over the kidney together, and thus producing kinking of the large intestine.

Partial Nephrectomy. This has been rendered justifiable by the results of experiments on animals. Morris [1] says, " Tuffier's experiments on animals, in 1888, and Barth's histological researches supply ample proofs of the healing power of the kidney, and the process by which healing is accomplished, even after extirpation of considerable portions. Paoli, of Perugia, performed extra-peritoneal operations for resection of the kidney upon twenty-five dogs, cats, and rabbits, with perfect recovery."

Morris records ten cases of partial excision for disease—tuberculous foci, traumatic abscess, containing a secondary calculus, a cyst, and a fistula—he has excised up to nearly one-half of the kidney for tubercle.

All the ten cases recovered from the operations but one required total nephrectomy a week later for acute general pyelo-nephritis, and died three months afterwards from general tuberculosis. Another needed nephro-ureterectomy seven months later, and in another symptoms returned within a year. The rest were well in 1900 except one who had died of acute broncho-pneumonia three years after the operation.

Morris also gives a *resumé* of eleven operations (from foreign literature), three for cysts, three for calculous pyonephritis, two for new growths, and one each for puerperal pyonephritis, renal fistula, and a patch of interstitial nephritis mistaken for malignant disease.

None of these cases died ; nine made good recoveries, one required nephrectomy, and in one fistula resulted.

Ramsay [1] mentions nine cases of partial nephrectomy for tuberculous disease ; in only two of these, however, was the result satisfactory. One, reported by Israel, was well one year later ; the other, by Morris, was well two years later.

This operation may also be performed in cases of laceration of the kidney by injury, where the greater part of the organ is uninjured. Here the organ will very likely be healthy, and removal of an almost detached part may be sufficient to arrest the hæmorrhage. Mr. Keetley has recorded a case of this kind : [2]

A young man had been crushed by a waggon-wheel. There was laceration. Five or six hours after the accident he showed signs of serious recurrent hæmorrhage. Through an incision a mass of blood-clot was scooped out, also the separated lower end of the kidney, a deep bleeding-point being compressed with sponges, which were removed in twelve hours. Convalescence was rapid. No urinary fistula or hydronephrosis resulted.

It may be said, therefore, that where, on examination of the kidney, a suitable opportunity presents itself, partial nephrectomy may be performed, and the greater part of the kidney in this way saved. The wound in the kidney may be sutured or the hæmorrhage may be arrested by means of plugging with aseptic gauze, suturing being the preferable method where possible ; for in this way both hæmorrhage and escape of urine will be prevented, and rapid healing of the whole wound thus secured.

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[1] *Loc. supra cit.*   [2] *Lancet*, 1890, vol. i, p. 134.

In view of the unsatisfactory results, with a few exceptions, that have attended this method of treating tuberculous disease, and of the great difficulty there must be in making certain that all disease has been removed, it would seem wiser to remove the entire kidney in such cases if the opposite organ is known to be healthy. Hurry Fenwick [1] states that he would only be content with a resection when " the disease was evidently limited to one pole as demonstrated by slitting the organ from end to end and down into the pelvis."

Sir H. Morris [2] gives the following statistics of his cases : (a) In twenty-nine nephrectomies for calculous disease, there were five deaths ; (b) in twenty-four nephrectomies for hydro- and pyonephrosis there were three deaths ; (c) in twenty-two nephrectomies for tuberculosis there were five deaths ; (d) in seventeen nephrectomies for tumour there were four deaths ; (e) in three nephrectomies for fistula there were no deaths. Thus, there were seventeen deaths out of ninety-five cases.

Tuffier's statistics published in 1899 give a mortality of 28·4 per cent. in 200 lumbar nephrectomies, and 44·1 per cent. in 161 transperitoneal nephrectomies. At the present time the mortality is much lower. In 33 nephrectomies the writer has had two deaths, one from lobar pneumonia and the other from uræmia.

NEPHRORRAPHY OR NEPHROPEXY

It is well known that nephrorraphy has not always been followed by the relief expected. This, I think, is due to one or more of the following causes :

(1) The operation has been performed in unsuitable cases. (A) Cases where the mobility of the kidney is only, in reality, a small part of the trouble. Well-marked instances of this group would be those cases where mobility of the kidney coexists with a markedly neurotic tendency, a group in which, were it not for the above tendency, the mobility of the kidney would be little complained of ; a group in which operation has been resorted to far too often, thus bringing much discredit upon it ; a group, finally, in which nephrorraphy is rarely to be resorted to, and then only with the greatest caution.[3] In dyspeptic, neurotic women approaching the menopause the operation should be avoided altogether. In the neurotic tendency lies one of the chief difficulties with regard to making a decision on the question of operation. The frequency with which a highly nervous temperament is present suggests the obvious question, Would these symptoms have arisen were it not for the neurotic tendency ? Any honest medical man would answer that in the majority they would not. In a certain number the mobility of the kidney determines the region and distribution of the neurotic trouble ; in a very few it originates and causes the neurotic tendency.[4] Care should be taken not to attribute to a movable kidney symptoms really due to other causes, such as dyspepsia, appendicitis or gall-stones, for it is certain that many healthy women have freely movable kidneys. Larrabee [5] examined 272 women for movable

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[1] *Med. Ann.*, 1906, p. 296.   [2] *Surgery of the Kidney and Ureter*, vol. ii, p. 275.
[3] In an interesting paper by Dr. Drummond (*loc. infra cit.*), thirty cases of movable kidney are given, two of which were treated by nephrorraphy. Both relapsed. In a third case, the details of which were supplied to Dr. Drummond, " excision of the movable kidney was practised without any relief."
[4] As in the rare cases where a man, previously active and healthy, has his life spoilt and becomes hypochondriacal after one kidney has become movable.
[5] *Boston Med. and Surg. Journ.*, November 26, 1903.

kidney, and found it in 112 or 41·5 per cent. ; in 39 it was merely palpable on deep inspiration ; in 49 it could be kept down during expiration ; in 24 it could be pushed about freely ; in 40 cases there were no symptoms ; and in 66 some loss of weight ; only 6 patients gave a history of " Dietl's crises."

Gordon [1] relates an interesting case in which a movable kidney was thought to be the cause of indigestion, constipation, and attacks of pain in the right side. Nephropexy failed to give relief, and later a simple stricture of the sigmoid flexure was discovered during an exploration for intestinal obstruction which proved fatal.

Again, where the mobility of the kidney is associated with a general proptosis of the viscera, especially of the liver, with long-standing dyspepsia or constipation, or with uterine or ovarian trouble, it will be useless to perform nephrorraphy, unless the other ailments can be corrected—a matter of no little doubt and difficulty in some of those patients in whom we meet with this disorder. (B) In a certain proportion of movable kidneys—and this, perhaps, a larger one than is usually allowed—organic disease coexists as well. I have met with several cases of this kind. In one the kidney was the site of carcinoma ; in a second, early tubercular disease must have been present. About two months after the nephrorraphy, pain having returned, further examination showed that the urine, which had before been found normal, contained pus. At a second operation two early foci of tubercular suppuration [2] were found and the kidney was removed. Six years later the patient was alive and well. In several cases the mobility was associated with hydronephrosis. The question of nephrorraphy in hydronephrosis is referred to below. In many cases chronic appendicitis is the cause of pain erroneously referred to movable kidney. In others gall-stones have caused the pain.

Mr. F. E. Taylor [3] records five cases in which unsuspected lesions were discovered during the operation of nephropexy. Three of these cases occurred in a series of thirty hospital patients. Renal calculi were discovered and removed in two cases, and tuberculous disease in two others, in one of these partial nephrectomy of the lower pole was performed, and in the other nephrectomy was necessary. The fifth case was one of hydronephrosis associated with movable kidney, and probably due to the mobility.

Taylor concludes that an operation is indicated when " some unusual or unexplained symptom is present, and still more if any tenderness or enlargement of the kidney can be made out." He also pleads for a more thorough examination of the kidney during the operation, and that the organ should always be brought outside the loin and carefully palpated and inspected, and even incised if any doubtful spot is discovered.

(2) Another frequent cause of nephrorraphy failing to give permanent relief is the way in which the operation is performed. Too much reliance has been placed on removing some of the fatty capsule and

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[1] *Lancet*, 1903, vol. i, p. 1587.

[2] My silk sutures, with which the kidney had been fixed, were found *in situ*, but as the collections of pus were on the inner aspect of the kidney, I do not think they dated to the stitching, in which the kidney substance had been boldly taken up. The early appearance of pus after the nephrorraphy is, however, suspicious, and it is quite possible that in delicate patients the injury inflicted by suturing might be the starting-point of tubercular disease of the kidney.

[3] *Ann. of Surg.*, 1904, vol. xl, p. 215.

suturing its edges to the lips of the wound with gauze packing, but without passing any sutures through the fibrous or true capsule of the kidney. A little experience was sufficient to convince Hahn that this method which he introduced was insufficient. Frequently the kidney is already movable within this capsule, and no good results ; and where no such mobility has existed, the loose fatty tissue, however carefully pulled out, tightened and stitched, gradually stretches and ceases to fix the organ. In other cases—and this is very frequent—the kidney tissue itself is deeply traversed by the needle. Now, the friability of the kidney is well known. Every operator who has passed sutures in this way is familiar with their tendency to cut through before or just as they are finally tightened and tied. So soft is the tissue of the kidney, especially when injured and inflamed—as around a suture—that I believe, when unabsorbable sutures thus passed have been left *in situ*, their cutting through is only a matter of time, and that catgut sutures unless well hardened are very soon absorbed.[1] Moreover, there is another danger, not altogether a fanciful one, which may follow on deeply puncturing the kidney. A German surgeon, Barth, has seen a necrotic centre caused in the kidney owing to the occlusion of one of the arterial centres by the anchoring suture. A similar condition has been noted as the result of puncture. One of the large arteries was obstructed, hæmorrhagic infraction took place, and ultimately necrosis.[2] A fourth step that has been advised, scarifying the surface of the kidney and scraping the adjacent muscles and fasciæ, does not commend itself to me as satisfactory at the time or likely to be of permanent utility later. Sometimes the kidney is fixed too low down, hydronephrosis or pyonephrosis resulting. Mr. Bruce Clarke [3] records an interesting case of this kind in which the kidney had been fixed so low that it nearly touched the crest of the ilium. Hydronephrosis developed and Mr. Bruce Clarke replaced the kidney after proving that there was no obstruction in the ureter. The kidney was regaining its normal secreting power, and the patient was comfortable when last seen a few weeks after the operation.

Indications. To speak of the indications more exactly. Where an otherwise healthy kidney is very movable, especially where this dates in sensible people to an injury, if the surgeon is in doubt as to an operation, he should try and satisfy himself that other treatment, including a sufficient trial of a well-fitting apparatus,[4] has failed, that the pain, whether constant or paroxysmal, is *bona fide, and that it really cripples and spoils the patient's life.* Constipation and dyspepsia will of course have been treated, tight lacing given up, and a trial made of a well-fitting truss or belt, or a corset coming low down in front and so fitted as to gather up the lower part of the abdomen and its contents. Gallant [5] strongly

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[1] Dr. Newman drew attention to this fact several years ago (*Lects. on the Surg. Dis. of the Kidney*, p. 69) : " The sutures passed into the kidney became destroyed more rapidly than elsewhere ; the living renal tissue seems to have an unusual power of absorption."

[2] M'Ardle, *Brit. Med. Journ.*, 1894, vol. i, p. 526.   [3] *Lancet*, 1905, vol. i, p. 8.

[4] The best one that I know is the one recommended by Sir Frederick Treves (*Pract.*, January 1905) and made by Ernst : " It consists of a thin, carefully-padded metal plate, which exercises pressure upon the abdominal wall by means of two springs. The pressure concerns the lower and inner margins of the plate, so that the kidney is forced upwards and outwards." Since 1895 Treves has used the instrument for over 300 private patients, in 95 per cent. of whom " the truss has proved absolutely efficient." " With the truss on the patient has been able to take active exercise, to ride, and in an occasional instance, to hunt." The instrument must be very carefully fitted, and must be applied when the patient is lying down.

[5] *Inter. Journ. of Surg.*, February 1903.

recommends a corset of this kind. Thus, conditions of movable kidney which call for operation are :

(1) Frequent, severe, and spasmodic attacks of pain, or more or less continuous suffering.[1]

(2) Dietl's " crises " consisting chiefly of violent attacks of colic, nausea and vomiting, tenderness and distension of the abdomen, and sometimes shivering and rise of temperature. These attacks may be due to torsion of the vessels or nerves of the pedicle or of the ureter, or of the duodenum. Obstinate constipation due to kinking of the colon is sometimes relieved by fixing the kidney.

(3) Renal paroxysms of acute abdominal pain, rigidity of the abdomen over the kidney, " faintness, giddiness, and other symptoms of collapse " (Morris). These rare attacks are probably due to " acute renal dislocation " (Lancereaux), and torsion of the pedicle.[2]

(4) Another strong indication for nephrorraphy is early hydronephrosis. Here the operation is resorted to not only to save the patient from the pain caused by the movable kidney, but to " prevent the organ from bringing about its own destruction " (Lucas). Mr. Lucas[3] relates four cases in which mobility of the kidney allowed of displacement of the organ on its transverse axis, causing bending of the ureter,[4] and thus distension of the pelvis with urine. Two of the cases were treated by nephrorraphy, and when last seen remained cured. One of the cases in which the hydronephrosis was undoubtedly due to the displacement, seemed to show that the destruction of the kidney may occasionally go on without any severe attacks of pain. Mr. F. J. Steward[5] related two similar cases before the Clinical Society ; the mobility of the kidney had caused kinking of the upper end of the ureter. In each case the kink was easily corrected by replacing the kidney. After nephrorraphy the average daily excretion of urea increased from 167 grains to 277 grains in one case. The other patient had had her hydronephosis drained sixteen weeks before her admission into Guy's Hospital. The fixation of the kidney was successful in both cases.

(5) Extreme mobility, not restrained by any apparatus that the patient can bear, and preventing the patient from taking proper exercise or following her occupation.

It is always wise to examine the kidneys and ureters with the X-rays before the operation, so that a stone may not be overlooked. Pyelography may reveal a kink or stricture of the ureter.

The following questions arise as to the sutures. (1) What is the best material ? (2) What tissues are to be taken up ?

The answer to each of these questions is, in my opinion, a simple one. (1) I prefer to use catgut suitably prepared to resist absorption for about six weeks.

[1] Morris, vol. ii, p. 221.

[2] Dr. Weigall (*Australasian Med. Gazette*, November 1903) has published a most remarkable case of gangrene of the right kidney following torsion of the pedicle. The organ was removed in time to save the patient's life.

[3] *Brit. Med. Journ.*, 1891, vol. ii, p. 1344.

[4] This same displacement of the kidney, which occludes for a time the ureter, will also, by twisting the pedicle, affect its vessels. As Mr. Lucas points out, the vein will suffer more from pressure than the artery, thus causing turgescence of the organ generally as well as distension of its pelvis. Thus are brought about the nausea, pain, vomiting, &c., which have been described as strangulation or acute dislocation of the kidney. (Bruce Clarke, *Trans. Med.-Chir. Soc.*, vol. lxxvi, p. 263 ; *Brit. Med. Journ.*, vol. i, 1895, p. 575.)

[5] *Lancet*, 1905, vol. i, p. 1069.

(2) In answer to this question I am strongly of opinion that to ensure a permanent cure in nephrorraphy, the sutures should take hold of the proper capsule of the kidney itself, after this has been carefully peeled off in two flaps. I have tried other methods, *e.g.* inserting them through the substance of the kidney itself, either fastening them to each side of the wound and dropping them in, or passing them from one lip of the wound through the kidney and finally through the other lip of the wound. The longer I watched my cases the less reason had I to be satisfied, though the earlier results had been excellent.

Methods of operating. A great number and variety of operations have been invented and recommended for fixing a movable kidney. Many of them are not based on sound anatomical and mechanical principles, and others have been conceived in ignorance of Nature's ways of healing. No attempt will be made here to give an exhaustive account of all the ingenious devices that have been too often hastily recommended without allowing sufficient time to elapse for observation of the after results : only a few typical methods will be briefly described. Operations based on fixing the fatty capsule only have been proved to be unsatisfactory. There is little doubt from experimental and clinical results that firmer union occurs when the cortex of the kidney is bared, than when sutures which pierce the friable renal tissues are relied upon. Moreover such sutures are not quite devoid of danger, as already pointed out, and there are at least five cases on record in which these sutures have caused urinary fistulæ due to laceration of the kidney. It is true that the leakage was not permanent, but it was troublesome and avoidable ; in one case a second operation was required.[1] It is safer and better to pass the sutures through the capsule only, unless the latter is too thin to be relied upon. In my opinion the usual oblique lumbar incision gives more room and far better access to the kidney and allows a more thorough examination of the pelvis and ureter than the vertical incision advocated by some surgeons, and my experience of the prone position has not impressed me favourably, for it certainly embarrasses the breathing, and increasing venous congestion and bleeding. All attempts to fix the kidney through the peritoneal cavity are to be condemned as futile and unnecessary. Passing stitches through the pleura and diaphragm to endeavour to fix the upper end of the kidney is not to be recommended, because it is at least meddlesome and it is enough to secure the lower two-thirds of the organ. As regards the parietes, the kidney and its fibrous capsule should come into contact with the raw surfaces of the quadratus lumborum muscle and the deeper part of the parietal wound ; but the kidney must not be drawn too much into the wound, where it will be exposed to injuries, and especially liable to nephritis, soon after the operation, as shown by Wolff.[2] Fixation of the lower end of the kidney only in the attempt to get it into a high position may lead to anteversion of the organ or to stretching of the adhesions, due to the pressure of the diaphragm and liver on the upper pole. On the other hand, fixation at too low a level may lead to kinking of the ureter and to hydronephrosis, and perhaps to pain from the pressure of the corset at the waist.

For the average operator and an average patient it must be unwise to attempt to fix both kidneys at the same time, although Edebohls,

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[1] Clayton Greene, *Lancet*, 1904, vol. ii, p. 1711.
[2] *Deutsche Zeitschrift für Chirurgie*, Leipzig, 1897, xlvi, p. 533.

with his great experience, did not find this practice dangerous. In more than a third of his cases the double operation was performed.

To hope to get very firm adhesions from the granulation tissue formed as a result of gauze packing, scarification, or cauterising of the capsule with pure carbolic acid, is vain, for experience has proved that such adhesions are not, in the end, as strong as those obtained by primary union between raw surfaces kept in apposition by means of sutures. Carwardine,[1] however, advocates the use of carbolic acid and gauze packing for this purpose. He quotes eight cases and states he has been able to prove that very firm adhesions follow his method. Rest in the recumbent position for at least three weeks is essential for the success of the operation.

Operation. The kidney is first thoroughly exposed by the steps given at p. 522, an assistant keeping the organ well pushed up into the loin while the surgeon cuts down on it. I may here say that in some of these cases of very movable kidney the tissues around are so loose from the dragging and shifting to and fro of the kidney that they wrap round the organ very closely, and thus it is easy to injure the peritoneum, unless care is taken to open the fatty capsule only at the upper and inner end of the wound.

The kidney itself having been exposed, it is gently withdrawn through the wound, and thoroughly examined for signs of disease, the pelvis and the upper part of the ureter are examined for dilatation and stone. Then an incision is made with a very light hand all along the convex border from end to end. Unless the utmost gentleness is taken in the last step the tissue of the organ itself will certainly be incised, causing free oozing. With the handle of a scalpel or a blunt dissector, flaps of capsule are then deliberately but gently stripped off the kidney up to a point about halfway along its lateral surfaces, so as to raise sufficient flaps for the sutures to find a holding in. The flaps having been raised they are sutured with medium-sized sterilised catgut to the aponeurotic and muscular edges of the wound. To get a firm and permanent holding, each suture should take up plenty of capsule on the one side and a sufficient grip of the lumbar fascia on the other. I generally use upwards of ten sutures, perhaps six in one flap and four in the other. One word of caution should be added. This method of anchoring is so efficient that, unless care is taken, it is possible to fix the kidney, which has been drawn out, actually between and not beneath the lips of the wound. After one row of sutures, say the upper, has been inserted, tied and cut short, and the second merely inserted, care should be taken gently to push the kidney into its proper place in the loin, just under the wound ; the lower sutures are then also tied, cut short, and dropped in. Any oozing met with after stripping off the flaps of capsule will yield to firm sponge-pressure kept up by an assistant while the surgeon is putting in his sutures. If when all bleeding is arrested the wound is very carefully dried out, no drainage-tube will be required. In closing the wound I unite the edges of the muscles and fascia with buried sutures of chromic gut, and the skin with salmon gut. I recommend this method most strongly : it is both easy and efficient. Newman[2] employs a very similar method and speaks well of the results. He inserts a large drainage-tube between the kidney and the deeper parts of the wound in order to promote adhesions to the wound.

[1] *Bristol Med.-Chir. Journ.*, March 1905.   [2] *Surgical Studies, Renal case.*

Arbuthnot Lane [1] raises about ten triangular flaps of the capsule of the posterior surface of the kidney ; each flap is twisted and tied with silk brought through the muscles and fixed by tying the adjoining ligatures.

Blair [2] makes use of a very similar plan, but he only raises three flaps, two of which have their bases at the outer border and the other remains attached at the pelvic border. These are drawn untwisted through the fatty capsule, the lumbar fascia and the muscles of the back, and fastened with catgut sutures. " The peritoneum around the kidney is also sutured to the lumbar fascia so as to draw it taut over the anterior surface of the organ, as an additional support."

Edebohls' Operation.[3] The patient is placed in the prone position
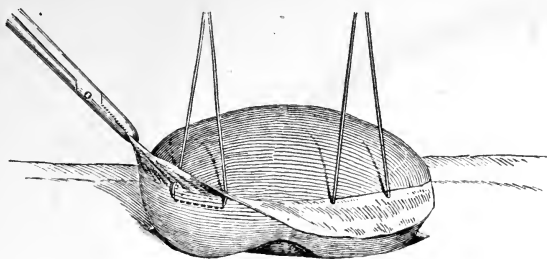
Fɪɢ. 235. Nephropexy (after Edebohls ; *Ann. of Surg.*). The suspension sutures placed in the fibrous capsule.

with an air cushion (fourteen inches long and eight inches in diameter) supporting the abdomen and pushing the kidneys well back into the loin. Edebohls maintains that this position does not embarrass the breathing or render anæsthesia difficult or dangerous ; it greatly facilitates the finding and delivery of the kidney.

A vertical incision is made along the outer border of the erector spinæ from the last rib to the iliac crest ; the fibres of the latissimus dorsi are separated, and the lumbar fascia is incised so as to expose the perirenal fat, and sometimes the ileo hypogastric nerve which may be drawn aside or divided and reunited later on.

The anterior lamella of the lumbar fascia is slit vertically and retracted in order to expose freely the muscular fibres of the quadratus lumborum, which are destined to form an adhesive bed for the kidney.

The kidney is sought and freed by the fingers, and together with its fatty capsule it is brought out on to the loin ; if the incision is too small to allow this, more room may be obtained by incising the outer fibres of the quadratus near the ilium. The fatty capsule is removed, and the kidney, pelvis, and upper part of the ureter are thoroughly palpated and inspected, or even incised if necessary. The fibrous capsule is nicked at the middle of the convex border and slit from pole to pole along a grooved director. Anterior and posterior flaps are raised by blunt-dissectors, so as to denude the outer half of the cortex ; some of the flaps may be removed if they are too large.

" Four suspension or fixation sutures of forty-day catgut " are passed through the fibrous capsule, two to each flap, as shown in Fig. 235. Each suture pierces the flap near its base and also the attached capsule under which it runs for a distance of two to three centimetres ; a Hagedorn

[1] *Clin. Soc. Trans.*, vol. xxv, p. 203.   [2] *Interstate Med. Journ.*, May 4, 1904.
[3] *Ann. of Surg.*, 1902, vol. xxxv, p. 174.

needle held on the flat is used to pass the suture to avoid penetration of the cortex of the kidney.

When all the sutures have been placed, the kidney is returned into position, and the anterior and posterior sets of stitches are passed
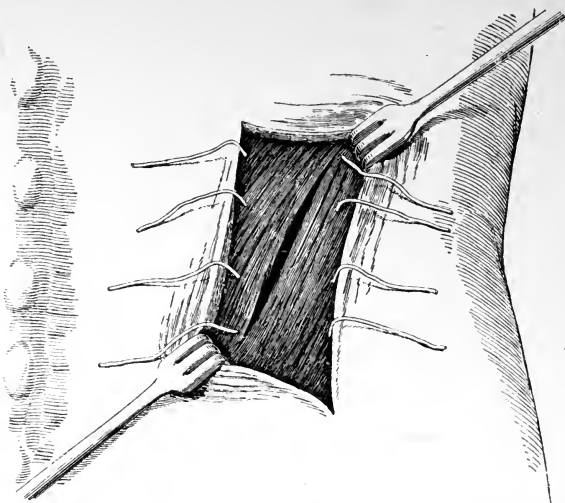
FIG. 236. Nephropexy (Edebohls). The suspension sutures piercing the muscles ; the fibres of the latissimus dorsi have been separated only.

through the parietes at a distance of about an inch and a half from each other. The inner sutures pierce the anterior lamella of the lumbar fascia, the quadratus lumborum, the erector spinæ and the latissimus dorsi, the outer ones pass through the lumbar fascia and the latissimus dorsi.
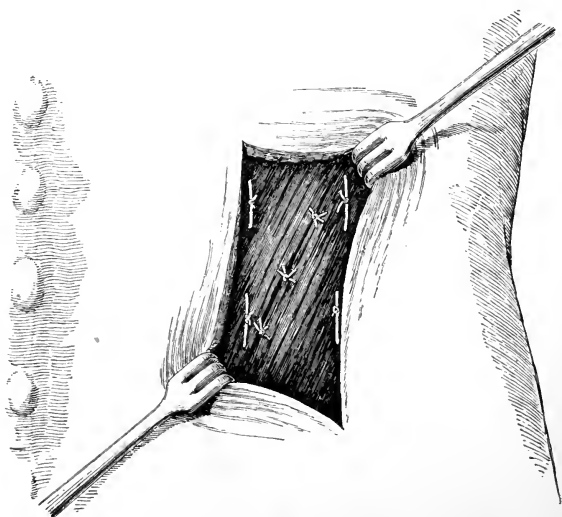
FIG. 237. Nephropexy after sutures tied. (Edebohls.)

The highest stitches are close to the last rib. The parietal wound is closed with catgut sutures " passed in such a manner as to turn the raw surface of the quadratus towards the kidney," and lastly the suspension

sutures are tied as shown in Figs. 236 and 237. The wound is not drained, but is completely closed by means of the intracuticular suture.

Edebohls does not claim that the kidney is fixed as high as the normal position, but that it is placed high enough for practical purposes. Moreover, he maintains that it is not wise to attempt high fixation, lest the liver in descending lengthen the adhesions, or cause anteversion of a kidney which has only been fixed at its lower part, which is common when high fixation is attempted.

So certain is he that other diseases frequently coexist with movable kidney, that he often opens the peritoneum to the outer side of the kidney, and explores the gall-bladder and ducts, the duodenum and pylorus, and especially the appendix, which he often removes through the loin. He then closes the peritoneum and proceeds with the nephropexy.

Morris' Operation.[1] Morris exposes the kidney through his usual oblique lumbar incision, and removes a considerable part of the perirenal fat, but he does not believe it to be necessary to interfere with the fibrous capsule in any way. He passes three silk sutures "into the posterior surface of the kidney, one nearer the upper, the other nearer the lower end, and the third midway between the other two, but nearer the hilum. Each suture is buried for a length of three-quarters of an inch within the renal substance, and penetrates about half an inch into the thickness of the organ." The sutures are then passed through the edges of "the shortened adipose capsule, the transversalis fascia, and the deeper layers of muscles, and tied to them as shown in Fig. 238."

Only one of the sutures serves to narrow the parietal wound, which is closed by silk sutures passing through all the

FIG. 238. Nephropexy (Morris' Operation). Left kidney shown. The sutures are represented in the figure too near the hilum. (Morris.)

layers including the skin. A drainage-tube is often used. The wound usually heals in a week, but the patient is kept in bed for from four to five weeks. Mr. Morris sometimes uses Vulliet's method in severe cases in young women and speaks highly of it ; he also raises capsular flaps from edges of the renal wound when an exploration of the kidney has been considered necessary.

He considers that M'Ardle has exaggerated the risk of sepsis and phlebitis involved by sutures penetrating the renal tissues, and also that the danger of including one of the large renal arteries (Barth) is avoided by passing the sutures only from the posterior surface and not through the thickness of the organ. Morris has operated on more than eighty cases without a death.

[1] *Surg. Diseases of the Kidney and Ureter*, 1901, vol. ii, p. 231.

Goelet's Operation.[1] The kidney is exposed as in Edebohls' operation (p. 565), and the fatty capsule is dragged downwards and opened at the upper and inner angle of the wound to avoid opening the peritoneum or injuring the colon. Traction is made on the fatty capsule, and the kidney is delivered into the wound. The fatty capsule is completely separated from the kidney, and thus the duodenum and colon are detached from the anterior surface. The pelvis and ureter are searched for stone.

The capsule is neither detached nor split, as Goelet believes this to be unnecessary for firm union granting that non-absorbable ligatures, which do not stretch, are used, and that these are tied so that they cannot become loose by cutting into the tissues. Goelet uses silkworm gut made pliable by boiling and preserving in 3 per cent. lysol.

Two sutures are inserted into the posterior aspect of the free border kidney, one at the junction of the middle and lower third, and the other about the centre of the kidney (see Fig. 239). "A small fully curved needle one inch long is used to pass the sutures. The lower one pierces the true capsule at *a* and passes beneath it for half an inch to *b* superficially to it for nearly half an inch to *c*, deep to it for half an inch from *c* to *d*, and superficially from *d* to *e*, deeply from *e* to *f*. Goelet maintains that the strain upon the sutures " is in a direction parallel to the surface of the kidney and its capsule, and not at right angle to it," as in all other forms of suture used; therefore it requires great tension to make the stitch tear out.
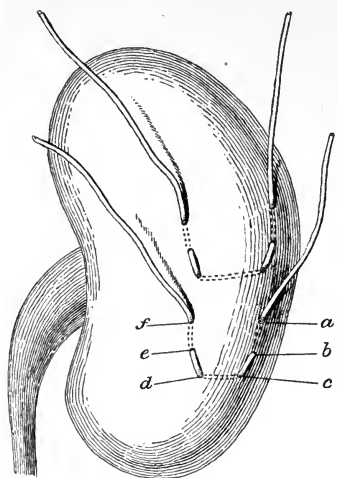
Fig. 239. Nephropexy (after Goelet; *Ann. of Surg.*). The suspension sutures placed in the true capsule. (Posterior view.)

All redundant fatty capsule is torn off or excised with scissors, due care being taken not to injure the bowel or open the peritoneum. The kidney is then replaced, and the sutures are then passed through all the parietes near the upper end of the wound, by means of a long curved perineal needle (see Fig. 240). They are tied over a roll of gauze placed longitudinally. This forms a cushion for the suture loop to rest upon, and prevents the suture from cutting through the skin and consequent loosening of the loop. A gauze drain is packed around and below the lower pole of the kidney to keep back the fat which has not been removed. The wound is sewn up in layers, except at the lower angle where the gauze packing protrudes. The sustaining sutures are not removed until the twentieth day, and the patient is allowed to get up next day.

Goelet lays great stress on the importance of complete removal of the fatty capsule, and especially upon the detachment of the duodenum and colon to prevent these from dragging on the kidney. He also seems to think that he can prevent these structures from re-adhering to the kidney by means of gauze packing, and early stimulation of intestinal movements. He claims that he has had no recurrence in 171 operations on 134 patients, 37 of these having both kidneys fixed on the same day.

[1] *Ann. of Surg.*, 1903, vol. xxxviii, p. 769.

It may be objected that these cases had not been observed long enough for the conclusions to be final, for the first of the operations was only performed about three years before Dr. Goelet's paper was read.

The Mortality of Nephropexy. Morris reports 80 operations without a death, and Tuffier 75 with 2 deaths. The latter has also collected 173 records with a mortality of 4·4 per cent. for all operators.[1]

Edebohls collected records of 836 operations by surgeons with experience of at least 15 operations each ; the mortality was 1·65 per cent. Edebohls himself [2] reports 193 operations with 3 deaths, a mortality of
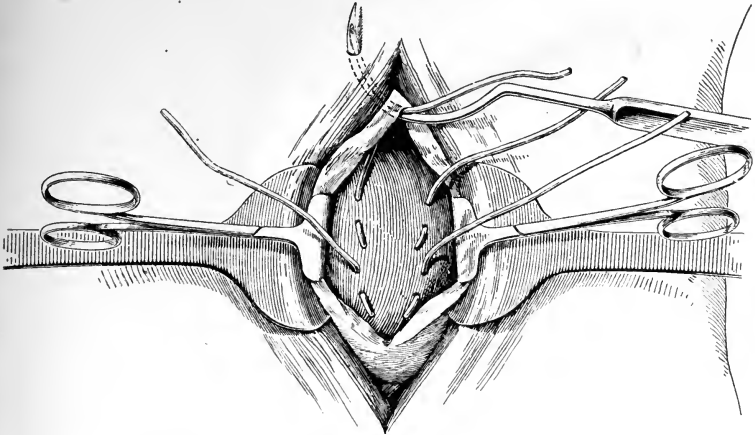
FIG. 240.   Nephropexy (after Goelet ; *Ann. of Surg.*).   The suspension sutures being passed through the whole thickness of the parietes.

1·55 per cent. More than a third of these patients had bilateral operations, and in 52 the appendix was also removed.   In 2 nephrectomy was performed on the opposite side at the same operation (a most hazardous proceeding).

Goelet records 171 operations on 134 patients without a death.[2]

Edebohls has also operated on 135 successive cases without a death, and he quotes Johnston as having operated 107 times without a fatality. It may be stated that at the present time the mortality should not be more than 1 to 2 per cent. for skilful and aseptic surgeons.

Deaths have occurred from sepsis, peritonitis, tetanus, pulmonary embolism, broncho-pneumonia, uncontrollable vomiting.   Pulmonary embolism is a common cause of death and is probably due to thrombosis of the renal vein, which may occur when the kidney has not been pierced by any suture ; it may be due to laceration of the lining of the vein during forcible attempts to deliver the kidney combined with the enforced rest that must follow the operation.   As far as I know, the clot has not been proved to be septic in origin.

Accidents that may happen during the operation.   Laceration of the kidney may occur during its delivery, but it is more common as the result of tension on sutures which pierce the kidney.   Edebohls [3] reports a case in which a fistula persisted for three and a half months, and he refers to three other cases.

[1] Morris, *loc. cit.*, vol. ii, p. 236.   [2] *Loc. cit.*
[3] *Ann. of Surg.*, 1902, vol. xxxv, p. 157.

Clayton Greene [1] has reported an interesting case, which is probably unique. A fistula followed the use of deeply penetrating catgut sutures. It closed after the removal of some deep sutures, but six months later another operation was required for pain and swelling. A clear fluid, presumed to be urine, was found within a greatly thickened true capsule, which was detached from the kidney, except at the hilum. Mr. Clayton Greene calls this condition external hydronephrosis.

The peritoneum may be opened, because the liver may be mistaken for the kidney. The colon may be wounded, and the pleura has been opened causing temporary pneumothorax. The ureter has been torn.

Complications. Septic infection, nephritis, neuralgia from section or involvement of nerves in the scar.

Hernia may occur, but Edebohls was only able to discover records of nine cases.

Results. It is to be regretted that some of the energy devoted to inventing and publishing new methods is not spent on following cases and recording ultimate results.

Very few statistics are of any great value, because the patients have not been examined after a sufficient length of time ; it is absurd to claim cures after a few months only, for it is well known that fibrous adhesions often stretch, and even vanish in time. The scar that follows free drainage for suppurative peritonitis seems firm enough for some months, but a ventral hernia often appears later.

Goelet [2] claims that he has only had one partial failure after 171 operations, but his cases could not have been observed long enough to justify this optimism, for the first of the operations was performed only three years before the results were published.

Edebohls [2] maintains that not a single one of the kidneys which he has anchored has, to his personal knowledge, again become movable. Every one knows, however, that it is practically impossible to trace all cases, especially failures, which often go elsewhere. The following figures are of more value, being more definite : In 1898, Edebohls personally examined 55 of his patients which had been operated upon from one to eight years previously. In 50 the kidney was firmly fixed ; in 5 the adhesions had stretched more or less, but none of the kidneys could be pushed up under cover of the ribs, as in an ordinary movable kidney. Edebohls therefore asserts that they are not detached. One seemed to be movable enough to require a second operation, which showed that the kidney was fixed, and could not be detached without tearing the renal tissues. Keen, quoted by Treves, gives the results of 116 operations. After three months only 57·8 per cent. were regarded as cured, and 12·9 per cent. improved, and 19·8 per cent. were considered to be failures.

McWilliams [3] records 61 cases, of which 42 were traced ; 22, or 52 per cent. were considered to be cured, and 15, or 35·7 per cent., benefited, and 5 cases, or 10 per cent., not benefited. Of 19 simple cases, 12, or 63 per cent., were cured. Out of 23 complicated cases, 10, or 43 per cent., were cured ; 2 of the 61 died, giving a mortality of 3·2 per cent.

The results must be judged by a more important test than that of

[1] *Lancet*, 1904, vol. ii, p. 1711. [2] *Loc. supra cit.*
[3] *Med. News*, October 4, 1902.

mobility ; it is far more essential to know if the patient has or has not obtained relief from her symptoms.   The relief of symptoms will generally prove both the accuracy of the diagnosis and the efficiency of the treatment.   It is poor consolation to know that a kidney has been fixed when symptoms supposed to have been due to its mobility still persist. On the other hand, it matters little if a kidney become slightly too movable if the patient does not suffer *from it*.   It is to be hoped that more prominence may be given to these points in future statistics.

THE SURGICAL TREATMENT OF NEPHRITIS

Mr. Reginald Harrison [1] was the first to advocate surgical treatment for nephritis ; he suggested that the improvement which may follow chance operations upon kidneys which are in a state of chronic nephritis might be due to the relief of tension within the capsule of the kidney. Harrison therefore practised and recommended renipuncture for Bright's disease, later he performed capsulotomy and nephrotomy.

Israel in 1899 drew attention to the disappearance of symptoms of renal disease after negative explorations for stone, but he did not recommend surgical interference for Bright's disease. [2] Ferguson, Edebohls, and Pousson, in 1899, advocated surgical intervention in certain cases of nephritis, including chronic Bright's disease.

In view of the grave prognosis of this disease under medical treatment, it is certainly worth while to consider the advisability or otherwise of seeking aid from surgery, but it remains to be proved that operations are either hopeful or even justifiable in any cases of genuine Bright's disease (*see* p. 513).

Two operations require consideration. (1) **Harrison's operation.** [3] The patient having been anæsthetised, the kidney is exposed through the usual oblique lumbar incision (*see* p. 522) ; the fatty capsule is opened, and an assistant pushes the kidney towards the operator.   It is not necessary to deliver the organ on to the loin unless the diagnosis is uncertain, and a thorough examination is indicated on that account.

The fibrous capsule is exposed and incised along the convex border for a distance of about two or three inches.   In some cases Harrison punctures the kidney in various directions, avoiding the pelvis ; in others he incises the cortex more or less freely.

The wound is only partly closed, a drainage-tube being inserted and left in position for a week or ten days.   Drainage is considered to be an essential part of the treatment.   In a case of nephritis it does not matter which kidney is selected for the operation, unless pain is present on one side.

" Both organs are usually involved in the inflammatory condition, though perhaps it may turn out not to the same degree.   In double nephritis, the relief of tension in the one organ aids the other, and thus, as I have noticed on several occasions, the normal amount and constitution of the urine becomes re-established."

The Indications for the operation as given by Mr. Harrison, at the International Congress at Lisbon, 1906, [4] are as follows :

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[1] *Brit. Med. Journ.*, 1896, vol. ii, p. 1125.
[2] *La Sem. Med.*, February 5, 1904.
[3] *Lancet*, 1901, vol. ii, p. 330.   [4] *Ibid.*, 1906, vol. i, p. 1202.

" (1) Progressive signs of kidney deterioration as shown by the persistence of increase of albumen when it should be disappearing from the urine, as in the natural course of inflammatory disorders ending in resolution.

" (2) Actual or threatened suppression of urine.

" (3) Where marked disturbance of the heart and circulatory system occurs in the course of inflammatory renal disorders."

A consideration of the pathology of Bright's disease, of the experimental evidence (*see* p. 574), and of the theory of renal tension, does not commend this operation to me ; it is almost certain that any relief that may be derived from an operation may be obtained with far less risk by medical treatment.

The following remarks made by Mr. Henry Morris, after a vast experience of diseases of the kidney, show how dangerous operations may be in Bright's disease : " Surgical operations and more especially operations upon the urinary organs, if it be possible to postpone them, should never be undertaken during the existence of acute or sub-acute interstitial nephritis, or any form of ' congestive ' urinary fever." [1]   When a series of consecutive cases treated by operation is published and the results are found to compare favourably with those obtained by less heroic measures, physicians may no longer shrink from submitting their patients to operation, but until then discretion is certainly the best part of valour.

(2) **Renal Decapsulation.** Edebohls " originally devised, proposed and performed " this operation for the treatment of chronic Bright's disease.[2] He exposes the kidney through the vertical incision, which has already been described under nephropexy at p. 565, and the patient is placed in the prone position with an air cushion supporting the abdomen. Both kidneys are therefore accessible without changing the patient's position.   The following description is taken from Dr. Edebohls' paper in the *Brit. Med. Journ.*, 1902, vol. ii, p. 1507 : " If possible, next deliver the kidney into the wound or out upon the skin of the back, a procedure which greatly facilitates further operative procedures in both renal decapsulation and nephrotomy.   When such delivery of the kidney is impossible, the rest of the work must be done at a great disadvantage with the kidney well up underneath the lower ribs and with the fatty capsule constantly overlapping the organ to a greater or less extent." By adopting the usual oblique incision it is much easier to bring the kidney into the wound, especially in men and in patients with a small interval between the last rib and the iliac crest, and the risk of hernia is very small if the muscles are sutured carefully.

" In performing renal decapsulation the operator next proceeds to bluntly separate the fatty capsule from the capsule proper, the dissection being continued on either aspect and around both poles of the kidney until the renal pelvis is reached.   Now and then the fatty capsule may be found so thickened and adherent, as the result of chronic perinephritis, that the scissors or knife may be required to separate it from the capsule proper.   The kidney with its capsule proper is next lifted from its fatty capsule bed, and if possible delivered into or through the wound.   The capsule proper is divided on a director along the entire length of the convex external border of the kidney and clear round

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[1] *Surgical Diseases of the Kidney and Ureter*, vol. i, p. 316.
[2] *Med. Rec.*, December 21, 1901, pp. 961–970, and *Med. News*, April 22, 1899.

the extremity of either pole.   Each half of the capsule proper is in turn stripped from the kidney and reflected toward the pelvis until the entire surface of the kidney lies raw and denuded before the operator.   In separating the capsule proper from the kidney care must be taken not to break or tear away parts of the kidney substance, which is often very friable and very firmly connected with the capsule proper, especially in the presence of chronic interstitial nephritis.   I have found the smooth surface of the index finger of the rubber gloved hand the best instrument for safely effecting separation of the capsule proper from the kidney. The stripped-off capsule is next cut away entirely, close to its junction with the pelvis of the kidney, and removed.   Delivery of the kidney into the bottom of or out of the wound greatly facilitates the decapsulation part of the operation, whereas if the kidney cannot be readily reached, the operation sometimes becomes very difficult.   In the latter event the entire kidney capsule proper may have to be peeled off at a finger's capsule on the bottom of the wound beyond the reach of sight."   All the length should be excised if possible, but if this is not practicable the small remainder should be separated and everted towards the root of the kidney.

The kidney is dropped back and the wound closed without drainage except under exceptional circumstances.   Both kidneys are operated upon at one sitting so as to avoid the dangers of two anæsthetics, which is important in these cases of nephritis.   "Decapsulation of both kidneys for chronic Bright's disease requires for its performance from half an hour to one hour from the first incision to complete closure of both wounds and the application of dressings." . . . "Decapsulation of one kidney is, in itself, less serious than either nephropexy, nephrotomy, resection of the kidney or nephrectomy."

Edebohls has performed his operation not only for cases of Bright's disease, but also for acute pyelo-nephritis with miliary abscesses, hydronephrosis, pyonephrosis, polycystic kidney, and puerperal eclampsia.[1]

It is probable, as he admits, that the cases of ascending suppurative nephritis would have recovered without operation.   In two cases decapsulation was only used in addition to nephropexy, for mobility, and the benefit undoubtedly derived from the combined operation was almost certainly due to the fixation, which may perhaps have been made more secure by the removal of the capsule.[2]

From observations which were made during three secondary explorations upon kidneys, which had previously been fixed, Edebohls concludes that decapsulation allows anastomoses to occur between the vessels of the perinephritic tissues and those of the kidney, and that this may provide an additional blood-supply to the organ.   An increase of blood-supply may lead to absorption of the inflammatory products, and to the removal of pressure upon the tubules and glomeruli, which may then resume their normal function.   It is not claimed that improvement is rapid, but that it is progressive, albumen only disappearing after from one to twelve months.

Edebohls [3] states that decapsulation for chronic Bright's disease has been performed in 200 to 300 cases.   He recommends the operation for every case of chronic Bright's disease which has a reasonable expectation

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[1] Two successful cases (*Boston Med. and Surg. Journ.*, June 2, 1904).
[2] *Brit. Med. Journ.* 1902, vol. ii, p. 1507.
[3] *New York Med. Journ.*, May 21, 1904.

of life of not less than one month without an operation, if no contra-indication to any operation is present and if the services of a surgeon of experience can be obtained. He does not regard cardiac complications as contra-indications unless the heart is dilated and weak, but albuminuric retinitis is considered to be an absolute objection, for of all the nine patients having this complication, not one survived the operation for a year.

Edebohls had operated upon 72 patients up to the end of 1903. Of these 47 survived and had been traced for periods varying from 6 months to 12 years, 19 of them suffered from chronic diffuse nephritis, 17 from chronic interstitial nephritis, 7 from chronic parenchymatous nephritis, and 4 had chronic interstitial nephritis of one kidney and chronic diffuse inflammation of the other. Twenty-one of the patients were cured, and only six were not improved to some extent, the greatest improvement occurring in the cases of chronic interstitial nephritis, and the least in the chronic diffuse nephritis.

Edebohls states that strict asepsis is essential for success as the subjects of nephritis do badly if their wounds suppurate.

Walker Hall and G. Herxheimer [1] found that a new capsule thicker than the old one forms within about three weeks in rabbits. Johnson was unable to find any anastomoses between the renal and perirenal vessels in dogs, and Tuffier [2] arrives at the same conclusion, after failing to induce any anastomosis by tying the renal vein and constricting the renal artery of the decapsulated kidney.

Claude, Balthasard, Jaboulay, and Gifford [3] did not find any marked anastomoses between the decorticated kidney and the adherent tissues of rabbits ; acute nephritis, induced by injection of neutral ammonium chromate, was not influenced by decortication undertaken three days later (Hall and Herxheimer). Decapsulation has been even shown to induce interstitial nephritis in some rabbits. If decapsulation does any good, it probably acts by relieving tension and congestion.

Hubbard [4] reports seven cases of decapsulation of the kidney, but albuminuria did not cease in any of the patients, and five of them died within six months of the operation, two within nineteen days. Freeman [5] records a case of unilateral hæmaturia for which decapsulation was performed ; the surface of the kidney " was granular and mottled yellowish grey, and the fibrous capsule adherent." A small piece was removed and examined ; the glomeruli and interstitial tissues were in-flamed. No return of hæmaturia occurred during the seven months of observation before publication. A cure should not be claimed in this short time, for the man had suffered from attacks of hæmaturia on and off for twenty years.

Baker [6] has endeavoured to improve the operation by bringing a piece of omentum backwards through a peritoneal perforation and wrapping it round the kidney. As the omentum is far more vascular than the perirenal fat, a freer anastomosis is expected to form. Tuffier [7] found even this to be of no avail.

Berg [8] advises decapsulation in cases of nephritis which have reached a stationary stage, and in which medical treatment is of no more avail. He believes that nephritis due to sclerosis of the vessels or to chronic suppuration is not benefited by the operation.

Ramon Guiteras [9] found that the leading American surgeons are about equally divided for and against the operation of decapsulation for chronic nephritis. Of 120 cases which he collected 16 per cent. were cured, 40 per cent. improved, 11 per cent. unimproved, and 33 per cent. died. The mortality in chronic interstitial nephritis was 26 per cent., and that of chronic diffuse nephritis 75 per cent.

H. J. Whitacre [10] records a case of suppression of urine which had lasted for eight days, and was then relieved by decapsulation of both kidneys, but suppression is occasionally relieved without any operation.

Whether decapsulation will ever become a recognised method of treatment of intractable cases of chronic Bright's disease is

[1] *Brit. Med. Journ.*, April 9, 1904. [2] *Presse Med.*, April 1905.
[3] *Med. Rec.*, July 1904. [4] *Boston Med. and Surg. Journ.*, January 28, 1904.
[5] *Ann. of Surg.*, vol. xxxix, 1904, p. 370. [6] *Zeut. f. Chir.*, 1904, No 14.
[7] *Loc. supra cit.* [8] *Med. Rec.*, June 18, 1904.
[9] *New York Med. Journ.*, November 7, 1903.
[10] *Journ. Amer. Med. Assoc.*, May 23, 1903.

uncertain. So far it has not found favour with English surgeons and physicians.

Theoretically there is little to recommend it, for a free vascular anastomosis can hardly be expected to form between the kidney and the anæmic fatty capsule which surrounds it. The tension within the fibrous capsule cannot be high for any length of time, for the capsule is thin and delicate in cases of chronic nephritis, and it is quite capable of stretching, as is shown by the rapid enlargement of the kidney, which occurs in acute nephritis, and in some cases of hydro-nephrosis. Moreover, the kidneys of chronic interstitial nephritis are usually smaller than normal, and still it is in these cases that decapsulation is claimed to do most good. It would be far more reasonable to take away or incise the dense and thick tunica albuginea from an inflamed testicle for the relief of tension, than it is to remove the thin capsule which invests a shrunken and chronically inflamed kidney. In acute nephritis, incision of the capsule might really be expected to relieve tension, but decapsulation has not been at all successful in these cases, although a few recoveries have followed operation for actual or threatened suppression of urine in scarlatinal nephritis. These results were not necessarily due to the interference, but may have occurred in spite of it.

Is it to be expected that decapsulation may arrest a renal degeneration and vascular sclerosis, that have gradually increased for years, in the majority of the subjects of chronic Bright's disease ?

Experimental evidence lends but little if any support to the advocates of this operation, and it fails to demonstrate any real anatomical reason for its supposed success. The literature of the subject is full of vagueness, inaccuracy and confusion. Cases of movable kidney, with or without nephrectasis, have been frequently classified as instances of Bright's disease, and even cases of ascending nephritis have been included. No one denies that decapsulation and fixation of a movable kidney may do good, and that the hydro-nephrosis and transient albuminuria which may be secondary to it may be cured by nephropexy.

Newman drew attention to this fact twenty years ago.[1] These cases should not be confused and classed with those of the bilateral and far more serious disease which was described by Bright.

Many writers seem to forget that patients not uncommonly recover from Bright's disease without operation, and particularly that spontaneous improvement may occur and last for a long time, only to be followed by relapse after months or years. Recorded cases, with few exceptions, have not been followed up for a sufficient length of time to justify their classification as cures. It may be seriously doubted whether the results in patients who survive the operation are any better than those obtained in the same time and with far less risk by medical treatment. Suppuration is apt to occur in the wound even when every care is taken to avoid sepsis, and Edebohls lays stress on the dangers of the anæsthetic in these patients.

The operation is very dangerous in acute nephritis, and it should not be undertaken in patients with cardiac dilatation and anasarca. Albuminuric retinitis is an absolute contra-indication.

It may be stated in conclusion that published facts do not lead us to hope for favourable results from surgical interference in Bright's

[1] *Lancet,* January 1886, p. 166.

disease. In suppression and perhaps in grave cases of eclampsia, an operation may not be more dangerous than leaving well alone, and time and experience may prove that incision of the renal capsule may give relief. In some cases of chronic interstitial and chronic parenchymatous nephritis, which have been medically treated without avail, the patients should be given the opportunity of declining or accepting an operation which may offer a faint hope of relief; but all the dangers and chances of the operation should be explained to the patients and their relations. Decapsulation of both kidneys offers the best prospect, but this should not be undertaken except by a skilful and aseptic surgeon, and under the most favourable circumstances.

CHAPTER XXXI

OPERATIONS ON THE URETER

THERE are two main conditions in which operations on the ureter are necessary :

A. **Ureteral Obstruction.**

B. **Injuries to the Ureter.**

A. **Ureteral Obstruction.** This in the great majority of cases is due to the impaction of a calculus in the ureter ; in others, however, it has been found to be due to a valvular formation at the opening of the ureter into the renal pelvis or to a stricture of the ureter. These conditions will be considered separately.

I. URETERAL CALCULUS. There can be no doubt whatever that in many cases, where a renal calculus has been diagnosed and no calculus found, the stone has really been in the ureter.

Morris[1] during his first twenty years' experience of renal surgery " had six cases in which a stone must have been present in the ureter at the time of the operation, although the kidney was explored with a negative result in each case." Five of these patients subsequently passed a calculus, and the other one died about a year later, and a stone was found near the lower end of the ureter. Other surgeons have had the same experience, but in many cases the stone has been fortunately found in the ureter near the kidney. At the present day there is less excuse for this error, which was unavoidable in the past, for the introduction and the perfection of systematic examination of all the urinary organs by means of the X-ray screen has provided the surgeon with a means of almost accurately localising calculi before any operation is undertaken for their discovery and removal.

Whenever possible such an examination by a trustworthy radiographer should precede all explorations of the kidney and ureter. This will enable the surgeon to reach the calculus by the most suitable route, with the least possible amount of injury to the patient, and also to avoid many an unnecessary exploration on the one hand, or an incomplete operation on the other.

The rays may show calculi on both sides, either in the kidneys or ureters or both. Tenney,[2] from an analysis of 134 cases of ureteral calculi, found that they were multiple in one-eighth of the cases.

It should not be forgotten, however, that small calculi, especially if they consist chiefly of uric acid, may be overlooked ; and yet that these may be large enough to produce a fatal anuria. In rare cases, other things, such as blood, inspissated pus, or hydatid cysts, may do the same. Moreover, a positive X-ray result may mislead ; cretaceous

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[1] *Surgical Diseases of the Kidney and Ureter,* vol. ii, p. 448.
[2] *Bost. Med. and Surg. Journ.,* February 4, 1904.

mesenteric glands, atheromatous patches in the arteries, phleboliths, calcifying centres in the pelvic ligaments, may occasionally lead to error. Fenwick has several times avoided these mistakes by passing into the ureter a bougie, which is opaque to the Röntgen rays.[1] Leonard,[2] however, in 330 examinations for renal and ureteral calculi found the negative and positive errors to amount to less than 3 per cent. After 51 negative results with the rays, the surgeon discovered no stones upon exploration in 47 ; but stones were either passed or found at operation in 4 cases.

The writer has removed many ureteral stones which radiography had failed to show. Cystoscopic examination after injection of indigo-carmine is invaluable in these cases, for little or no pigment may issue from the obstructed ureter.

Abdominal and vaginal or rectal palpation of the ureter also should be practised more frequently for diagnostic and localising purposes. A prolapsed ovary has been mistaken for a calculus, however, but this mistake may be avoided by remembering that a calculus in the lower ureter will be placed nearer the surface and antero-externally to the vagina, whereas a prolapsed ovary is softer, and placed behind the vagina.[3]

Intra-vesical palpation has served to discover a stone low down in several cases in the male and female (*vide infra*).

During operation upon the kidney and ureter, when there is any suspicion of the existence of a calculus or of any obstruction in the course of the ureter, it is always wise, if not imperative, to pass a ureteral catheter, bougie, or sound into the bladder, and also up into the pelvis of the kidney if the ureter only is exposed. The surgeon may thus discover a second stone or some other obstruction which might be otherwise easily overlooked and render the operation incomplete or useless, whether the X-rays have been used or not.

Impaction of a calculus may take place at almost any point in the course of the ureter, although in most cases it occurs at or near one of the three following narrow places :

(*a*) About two and a half inches below the hilum of the kidney, or about an inch below the junction of the renal pelvis and the ureter ; here the diameter is about one-seventh of an inch.[4]

(*b*) Near the pelvic brim ; here the diameter is about a quarter of an inch.

(*c*) At or near the vesical orifice ; at the orifice the diameter is only one-tenth of an inch.

Tenney [5] found that 35 stones were arrested at the upper constriction, 18 only at the middle, and 73 at the lower one. Bovée [6] records 22, 17, and 18 at these sites respectively. Morris in 44 operation records found that 19 were impacted near the kidney, 10 at the pelvic brim, and 15 at the extremity of the ureter.[7] Since then the same authority has operated upon 4 and collected 12 more cases ; in 11 of these 16 cases the impaction was at the lower end, and two others were found within three inches of the bladder.

[1] *Brit. Med. Journ.*, June 17, 1905.   [2] *Lancet*, June 17, 1905.
[3] Cullingworth, quoted by Morris, *loc. cit.*
[4] Deaver, *Ann. of Surg.*, vol. i, 1906, p. 733.
[5] *Bost. Med. and Surg. Journ.*, February 4, 1904.
[6] *Washington Med. Annals*, 1905, vol. iv, p. 233.
[7] *Lancet*, December 1899.

It may, therefore, be concluded that most stones will be arrested at the lower constriction, and that many more will be found at the upper constriction than near the pelvic brim.

A calculus placed within the renal pelvis, acting as a ball valve, may obstruct the orifice of the ureter and even cause fatal anuria ; but it must not be regarded as a " ureteral " calculus in the sense which is attributed to this word here.

Indications for Operation. (*a*) When the ureter of the only active kidney is obstructed and anuria exists, an immediate operation is imperative (*see* p. 533).

(*b*) When only one ureter is obstructed, there is not the same urgent need for treatment, for it is a matter of common experience that many ureteral calculi are passed naturally. Leonard [1] states that 26 of his 40 patients passed the stones which had been demonstrated by the X-rays. If a calculus is known to be small from an examination with the screen, and especially if it is shown to have descended between two examinations, and colic, but no complications, exist, expectant treatment may be tried for a few days, as recommended by Leonard. Large quantities of any alkaline mineral water may be given with the idea of increasing the volume and pressure of the urine, and urotropin or helmitol may be given with the object of keeping the urine aseptic. It is known that the kidney may resume its normal function after being obstructed more or less completely for weeks.

Immediate operation is demanded when :

(*a*) Another calculus, which is too large to travel along the ureter, is detected in either kidney, or the other ureter.

(*b*) When the calculus in the ureter is large and is really impacted and not merely passing down the duct. When the obstruction is complete or nearly complete, as shown by the small volume of the urine and cystoscopic examination, operation should not be delayed, lest the kidney be irreparably damaged.

(*c*) When there is evidence of any septic complication or of nephrectasis, as shown by fever, pyuria, and enlargement of the kidney or great tenderness in the region of the calculus. The writer removed a calculus in such a case—a very stout woman—after impaction for seven weeks. Although the kidney was in a state of ascending suppurative nephritis with nodular enlargements, it completely recovered in a few weeks.

Operation. (1) *Impaction of a Calculus at or above the Brim of the Pelvis.* In these cases the ureter can be sufficiently exposed by prolonging the incision already made for exploring the kidney as above described (*see* p. 522).

In some cases the dilatation of the ureter above the site of impaction will allow of the calculus being pushed gently along the ureter either up to the kidney or, at any rate, to some more accessible part of the ureter. Tuffier,[2] during a lumbar nephro-lithotomy, in which examination of the kidney revealed no stone, detected a hard oval body about three centimetres long, where the ureter crossed the pelvic brim. The stone was movable and was pushed up into the pelvis of the kidney, and removed by an incision into the convex border.

If the stone cannot be pushed up as far as the kidney, or is so tightly impacted that it cannot be moved, it should be removed through a longitudinal incision in the ureter. The incision in the ureter may be sutured

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[1] *Loc. cit.*   [2] Duplay and Réclus, *Traité de Chirurgie*, t. vii, 1892.

with fine catgut, passing through the outer coats, or it may be left without sutures. Deaver [1] uses two layers of sutures : catgut for the deep layer and silk for the outer coats. Mitchell and Corson [1] pass the sutures before incising the ureter. Should inflammatory thickening or ulceration of the ureter be present, it would seem wiser not to insert sutures. A number of successful cases, both with and without sutures, have been recorded. The following case, described by Dr. Kirkham,[2] is an illustrative one, and is, I believe, the first case in which a patient has been saved from death from suppression of urine by the removal of a calculus low down in the ureter :

The patient was 58. He had twice suffered from right renal colic, and had passed a small calculus. May 24, left renal colic came on. No urine was passed from this date till after the operation. May 30, the patient was drowsy, with prostration and muscular twitchings. Dr. Kirkham then explored the kidney in the hope that if no calculus was removed life might be saved by affording an outlet to the urine by an incision into the pelvis of the kidney. An incision was made from the tip of the last rib towards the anterior superior spine. No stone being found in the kidney, the exploration was continued along the ureter, in which a stone was distinctly felt about half an inch above where the ureter crosses the external iliac. There was a little difficulty in reaching the ureter in this part of its course, but after enlargement of the wound a calculus about the size of a date-stone was removed. A little urine escaped from the incision into the ureter. No sutures were placed in this. Half an hour after the operation an ounce and a half of urine was passed naturally. Very little escaped from the wound in the ureter, and the patient made an excellent recovery.

When it has not been possible to localise the calculus before the operation, experience shows that the lumbar incision is the best to adopt. In 28 out of 44 cases recorded by Henry Morris, this incision was used under the impression that the disease was renal, and in 25 of these cases the calculus was accessible. There is, therefore, a fair chance of finding the calculus and also of removing it through this incision.

Moreover, the kidney can be examined or removed if necessary, and if the other kidney is known to be healthy. In three of the 25 cases quoted by Morris nephrectomy was adopted. In any case a fistula can be established, and the kidney given a chance to recover.

If the stone cannot be found in the upper ureter, it should be sought with the ureteral sound, passed through an incision in the renal pelvis.

Should the stone be thus localised, it may be removed at once by prolonging the incision, or by making a separate anterior wound, if the stone is in the pelvis ; thus the liability to ventral hernia is diminished and an easier and more direct access obtained.

In some cases it may be wise to delay the removal of the calculus, for the latter may be passed naturally after a few days, when the kidney has resumed its normal function. The condition of the patient may be too critical to allow a prolongation of the operation, and the surgeon may then reluctantly remain content with establishing a temporary urinary fistula in the loin.

(2) *Impaction of a Calculus in the Pelvic Portion of the Ureter.* In the male, the greater part of the pelvic ureter can be exposed by a prolongation of the lumbar incision already made for exploring the kidney, as recommended by Morris.

Should the patient, however, be fat, and the lumbar incision already very deep, this method will be found to be extremely difficult. In such

[1] *Loc. cit.* [2] *Lancet,* March 16, 1899.

cases, and also in the female, the abdomen should be opened by an incision in the semilunar line or through the rectus sheath. In most cases it will then be found possible to push the calculus along the dilated ureter up to or near the kidney, when its removal can be accomplished through the lumbar incision, and the abdominal wound closed. This plan was first carried out by Lane in the following case : [1]

A woman, aged 23, had had symptoms of renal stone for twenty years, but there was nothing to point to the fact that the stone was in the ureter and not in the kidney, except that, associated with her renal pain, she complained at times of pain in the lower part of the abdomen on the same side, which did not appear to be reflected. The kidney was explored by the lumbar incision, and nothing was found either in this organ or in those parts of the ureter which could be reached from above or *per rectum.* The pain having returned with its original severity, the abdomen was opened along the left linea semilunaris, and in the portion of the ureter which had not been explored at the previous operation a small stone was felt. This was forced upwards along the ureter to the crest of the ilium, and by means of a small incision in the side the ureter was exposed and the stone removed. The aperture in the ureter was sewn up by a fine continuous silk suture. No leakage took place from the ureter, and the woman recovered completely, losing all her pain and discomfort.

Witherspoon [2] has modified Lane's method. Through the lower part of the rectus he opens the peritoneum and examines both ureters and kidneys, and having localised the stone, he sews up the peritoneum accurately, and peels it away from the parietes, so as to enable him to extract the stone extraperitoneally.

I strongly recommend this incision, but with modern methods of localisation, and of determining the condition of the other kidney, it will be rarely necessary to open the peritoneum for exploratory purposes. Moreover, the fallacies of this method have been already dealt with (p. 536).

The rectus incision has the following advantages :

It gives a very good view, which is unspoilt by hæmorrhage. It is extra-peritoneal, at least as regards the incision into the ureter. It is not very difficult to any one with a sound knowledge of anatomy. The risks of hernia and of injury of the cord are less than after the oblique inguinal incision mentioned below. Drainage is easily established.

The ureter is to be sought in the mesial aspect of the wound, attached to the displaced peritoneum. The finger of an assistant or a bougie in the rectum or vagina and a sound in the bladder may give valuable aid. Thus the stone may be more easily found, and the ureter containing it may be pushed upward into a more accessible position. Gentle endeavours may be made to push the stone upward into a more dilated, healthy, and visible part of the ureter. Care must be taken, however, not to use force, lest the ureter be damaged ; in one of Israel's cases (quoted by Morris) the duct was torn across. Attempts to crush the stone are not likely to succeed, and may injure the ureter. The stone can rarely be pushed on into the bladder because of the very small size of the ureteral orifice, and, moreover, it would be difficult to tell whether the calculus had really reached the interior of the bladder or had merely passed into the submucous parts of the ureter. Before sewing the longitudinal incision in the ureter, a bougie must be passed down into the bladder and up to the kidney. Sutures are not essential, and sometimes it may be a very difficult and tedious task to insert them ; but whenever possible they should be used, for the leakage may be at least diminished,

if not prevented entirely, in some cases.   The risks of extravasation and delay of recovery may thus be avoided.   Mitchell and Corson pass the sutures before incising the ureter, and take advantage of the stone as a guide and support.   Fine catgut is the best material.   The sutures should be so passed as to avoid narrowing the channel (Fig. 241).   In any case drainage of the wound is essential, for it is difficult to close the tube accurately in the depth of the wound, and leakage may occur even after the most careful suturing.

Gibbon [1] has adopted a similar method except that he does not suture the parietal peritoneum until he has extracted the stone, which he pushes
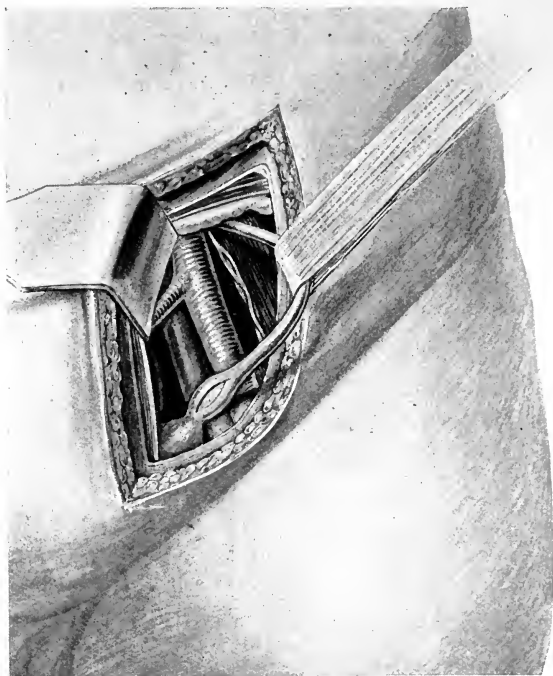
Fig. 241.

up into the extra-peritoneal wound by means of a finger within the peritoneal cavity.   He records two cases in which he successfully adopted this method, after discovering ureteral stones during exploration, in patients who had been sent to him supposed to be suffering from appendicitis.   The appendix and the stone were removed in each case, and both patients did well, but there is little doubt that it is safer to sew up the peritoneum (if opened at all) before incising a tube which has septic contents in most cases of calculous obstruction.

Mr. Betham Robinson [2] has successfully removed a stone situated close to the bladder of a boy of only three years of age.   He used an extra-peritoneal incision similar to the one commonly employed for tying the external iliac artery.   From an experience of this and two successful cases in adults, he concludes that the operation is much easier in the child, because of the absence of much fat in the abdominal wall and the

[1] *Ann. of Surg.*, 1906, vol. xliii, p. 742.   [2] *Lancet*, 1905, vol. i, p. 495.

small size of the child's pelvis, with the abdominal position of the bladder, so that the finger in the rectum was able to push the ureter and the stone well up into the wound. Care must be taken not to lacerate the thin peritoneum of the child.

Freyer [1] and a number of other surgeons have also used this method, and speak well of it.

Dr. Fowler [2] recommends this incision even for stones impacted very low in the pelvis.

Sampson [3] approaches the lower ureter through a low gridiron or muscular separation incision in the groin and recommends the adoption of either this or the incision through the rectus.

In no case is it wise or safe to remove a calculus from the ureter through the peritoneum, for however carefully the latter may be protected from soiling with urine during the operation, and however carefully and skilfully the surgeon may attempt to close the incision in the diseased ureter, it is the rule for the urine, which is usually septic in these cases, to leak at the line of suture. Therefore it is an accepted rule, that drainage of the neighbourhood of the sutures is essential to guard against probable urinary extravasation. Such drainage cannot be safely established across the peritoneum, and when the peritoneum covering the ureter is sewn up, extravasation may still occur into the undrained extra-peritoneal tissues and set up pelvic cellulitis.

These remarks are made with full knowledge that the trans-peritoneal method has been entirely successful in a few cases, of which the following is a brilliant instance, recorded by Mr. F. J. Steward : [4]

The patient was admitted for hæmaturia and painful micturition, which, in the absence of pain or tenderness over either kidney or ureter, were thought to be due to a vesical calculus. As the sound detected nothing, the bladder, after being distended with air, was opened above the pubes. Nothing was found in the bladder, but through its walls a stone could be felt in the lower part of the right ureter. As the stone could not be worked down towards the bladder, the wound was closed. Eight days later an incision about five inches long was made in the lower part of the right linea semilunaris, and the peritoneal sac opened. The stone was easily felt, and was gently manipulated up the ureter as far as a point a little above the iliac vessels. As it would go no further, the peritoneum and then the ureter were incised and the stone, weighing nine grains, removed. The ureter was then closed with a fine silk suture, taking up the outer coats only ; the peritoneum was then sutured in like maner, and the wound closed, with the exception of a small part through which a gauze drain was brought. No leakage occurred, and the patient made a satisfactory recovery.

(3) *Impaction at or near the Vesical Orifice.* In these cases the symptoms may very closely resemble those of stone in the bladder or cystitis. Judicious use of the cystoscope and bimanual pelvic examination may prevent the error in some cases. The mistaken diagnosis may be confirmed by the use of the sound alone, for the projecting part of the calculus may be touched. Freyer [5] relates three cases of this kind.

The vesical route is the best in these cases, *the urethra being dilated in the female.* Successful results have been recorded by Emmet, Berg, Richmond, Czerny, Sanger, Thornton, Freyer, and others. Millet evaginated the ureteral orifice through the female urethra, by means of a finger in the vagina, and he was then able to extract the stone.[6]

In some cases a fine alligator forceps can be introduced through the

[1] *Lancet*, vol. xi, 1903, p. 584.
[2] *Ann. of Surg.*, vol. xl, 1904, p. 943.
[3] *Ann. of Surg.*, 1905, vol. xli, p. 217.
[4] *Clin. Soc. Trans.*, vol. xxxiv.
[5] *Loc. cit.*
[6] Deaver, *loc. cit.*

female urethra by the side of the cystoscope, and used to remove a stone from the ureteral orifice.   Gellham records a case of this kind.[1]

In the male the stones are best removed by suprapubic cystotomy.   Morris refers to five cases in which this method was successfully adopted. Tuffier has also removed stones in this position twice by suprapubic cystotomy.   Crawford [2] succeeded in extracting a calculus measuring $1\frac{3}{8}$ inches in diameter in this way.   Freyer [3] removed ureteral stones in two cases through a perineal lithotomy wound, undertaken for the removal of vesical stones, for which the calculi had been mistaken by the use of the sound.

After several attempts Freyer [3] was able to grasp and remove a stone from the ureteral orifice of a man by means of a lithotrite, which was then used to crush it.   The calculus had been localised by means of the cystoscope.

It may be necessary to incise the mucous membrane or even the muscular wall of the bladder in order to free the calculus, but as long as the incision is not carried upwards for more than an inch the peritoneum will not be endangered.   While trying to grasp the stone with forceps, a finger placed in the vagina or rectum should be used to prevent the stone from slipping upwards out of reach.

(4) *Impaction low in the Pelvis, but not accessible from the Bladder.* Until lately it used to be believed that stones situated low down in the pelvis could not be reached or removed through the iliac or other extra-peritoneal route, especially in the female.

The experiences of Israel, Young,[4] Finney, Betham Robinson, and others, have proved that it is possible to remove a calculus from any part of the ureter down to the bladder wall through an iliac incision.   It may not be always wise to choose this route, however, for it may not be the easiest or the safest method to adopt in certain cases for various reasons.   In most cases it should be adopted, however, because the kidney and ureter can be examined at the same time.   Ceci records a fatal case in which he removed a calculus through the rectum; this route is not to be recommended on account of the danger of ascending suppurative nephritis.

The Vaginal Route.   Emmet, Cabot, Israel, Garceau, and others, have successfully removed ureteral calculi through the vagina.   It may be suitable for some cases in which the calculus is not more than two inches from the bladder.

Garceau [5] removed a stone impacted about three inches from the vesical orifice by incising the anterior vaginal cul de sac, and pushing away the peritoneum from between the bladder and the uterus, and then everting the broad ligament backwards, and hooking the calculus and the ureter downwards and forwards towards the vagina.   A small vaginal incision was then made, and the calculus squeezed out, and the incision was closed with sutures, which took up the outer coats of the ureter.   The operation took only ten minutes, and was entirely successful, no fistula resulting.   The stone was a large one, having a diameter of three-eighths of an inch.

This method carries the risk of pelvic cellulitis, which occurred in a case recorded by Freyer.[6]

[1] *Surg. Gyn. and Obst.*, November 1911, p. 578.   [2] *Amer. Med.*, vol. ii, 1904, p. 791.
[3] *Loc. cit.*   [4] *Loc. infra cit.*
[5] *Boston Med. and Surg. Journ.*, April 21, 1904.   [6] *Lancet*, 1903, vol. ii, p. 584.

In this case Freyer was unable to extract the calculus, because it slipped up out of his reach ; but it came away into the dressings.   Pelvic cellulitis supervened and delayed the recovery of the patient. A temporary or permanent uretero-vaginal fistula may also arise after this operation. Israel (quoted by Young), although he was able to remove two stones by this route, failed in two other cases, and had to resort to the iliac incision, which proved successful.   Therefore Israel did not attempt the vaginal operation in his two next cases.

Fenwick [1] has removed a calculus located two to three inches from the bladder through a small transverse perineal incision, but this method is not recommended for the reasons given by Young in his able article on the surgery of the lower ureter.[2]   He states that the wound is narrow and deep ; and that Regnier failed to reach the stone, and had to adopt the iliac method.   Moreover, the peritoneum may be opened unawares, and the kidney and ureter cannot be examined ; and the incision in the latter cannot be sutured.

The Sacral Route.   Sir Henry Morris [3] in February 1900 removed a calculus, which was impacted two to two and a half inches from the orifice of the left ureter, through the " sacral route."   Morris considered the calculus to be too high for removal by the vaginal method.   He made an incision five inches long parallel with, and to the left of, the vertebral spines, and two inches from the middle line.   It extended from the level of the third sacral spine to a distance of one and a half inches beyond the tip of the coccyx.   The gluteus maximus and the great sacro-sciatic ligament were divided and retracted.   Bougies were inserted in the vagina and rectum, and a sound was passed into the bladder.   " After some trouble the left ureter was found, and the part containing the impacted stone was pushed into the wound."   The stone was removed, and three Lembert sutures were used to close the ureteral incision.   A fistula lasted for nearly four weeks ; but the patient made a good recovery.

In another case Sir Henry Morris adopted this method for the removal of the lower part of the ureter of a patient whose corresponding kidney and upper part of the ureter had been removed for calculous pyonephrosis three weeks earlier.   The part of the ureter removed by the sacral route contained nine stones.

This method, which was first suggested by Cabot in 1892,[4] deserves attention because it has been adopted and recommended by so eminent an authority as Henry Morris ; but it is open to the following criticisms. It is unnecessarily severe, difficult, and destructive, and it does not allow a proper examination of the kidney and ureter, so that extensive disease of the one and a stricture of the other may be overlooked.   It is practically certain that any stone in the pelvis can be reached either by the abdominal extraperitoneal route or by the vaginal or vesical route.

Prognosis.   Extraperitoneal uretero-lithotomy is a very successful operation, which has a brilliant future.   With earlier and more accurate diagnosis, the operation will not only have a lower mortality, but will also save more kidneys from destruction by long-continued backward pressure and sepsis.

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[1] *Clin. Soc. Trans.*, vol. xx, p. 240.
[2] *Ann. of Surg.*, 1903, vol. xxxvii, p. 682.
[3] *Surgical Diseases of the Kidney and Ureter*, vol. vi, p. 469.
[4] *Amer. Journ. Med. Sci.*, 1892, p. 43.

Tenney [1] gives a mortality of 23 in 122 cases. Fowler [2] mentions 3 deaths in 21 operations, and Deaver [2] 2 deaths in 25 cases.

In 44 cases recorded by Morris [2] nephrectomy was necessary in four.

II. VALVULAR OBSTRUCTION. Simon, in 1876, gave theoretical directions for the relief of this condition. The first successful operation was, however, performed by Fenger, of Chicago, in 1892. The method of dealing with the condition may be gathered from the following *résumé* of Fenger's case.[3] The patient was a woman, aged 28, with intermittent hydro-nephrosis due to a movable kidney. The pelvis and calyces were first explored and no stone found. As the ureter could not be catheterised, a small opening was made in the posterior wall of the infundibulum, when a valvular obstruction was found at the upper end of the ureter where it joined the renal pelvis. The valve was divided vertically, and the ends of the longitudinal incision united by sutures, so as to convert the incision into a transverse one. The incision in the infundibulum was then closed with sutures, and the kidney fixed in the loin, a bogie being passed through the wound in the renal parenchyma and retained in position in the ureter for two days. The patient recovered without a fistula, and subsequently had no return of the hydronephrosis.

FIG. 242. Showing Küster's operation. (Morris.) I. Sac wall; c, transverse section of ureter. II. b, c, the ureter in transverse section, split on anterior side; at b and c, eleven sutures which connect the wings of the split ureter to the wall of the sac. III. a, the upper mouth of the ureter running in the wall of the sac, a, b; a, c, split line of the same in the anterior part of the canal. IV. The cleft walls of the canal pulled apart and fixed at a, b, c, inside the wall of the sac.

Morris [4] does not recommend leaving the bougie, for there is little fear of stenosis resulting, if the ureter be of normal calibre : " It delays healing, and it is liable to be followed by a temporary fistula. It is apt to excite ureteritis, and there may be marked difficulty in removing it owing to deposit of urinary salts upon it."

If the ureter be found to be adherent to the dilated pelvis, and opening into the latter too high for efficient drainage, a plastic operation should be undertaken. The valve or bridge between the lower end of the pelvis and the ureter should be incised from within the pelvis, which should be opened by a posterior vertical incision.

Recurrence of the malformation should be prevented by carefully suturing the edges of the incision in the septum in a longitudinal direction, as recommended by Mynter,[5] or by sewing the flaps to the inner surface

[1] *Loc. supra cit.*
[3] *Ann. of Surg.*, vol. xx, 1894.
[5] *Ann. of Surg.*, December 1893.

[2] *Loc. cit.*
[4] *Loc. cit.*, vol. ii, p. 435.

of the sac (Küster). The simplest way, however, is to excise the flaps. The exploratory incision in the pelvis should then be closed with fine catgut sutures, which should not pierce the mucous lining, and should be prepared to last for about twenty days, so that they may not become absorbed before firm union has occurred.

If the method recommended above is not practicable because the ureter is not adherent to the dependent part of the hydronephrotic sac, an incision may be made at the lowest point of the sac, and its edges joined to a longitudinal wound made in the ureter. The sutures should only pierce the outer coats of the sac and ureter. This method is not applicable when a narrow stricture exists in the ureter below the lower end of the sac, and then a portion of the ureter may have to be resected and the healthy end joined to the lower part of the sac, as in Küster's classical case. Küster's patient had a hydronephrosis of his only kidney draining in the loin, and Küster found first a valvular and elevated ureteral orifice, which he slit open; then he discovered a slight stricture in the ureter 2 c.m. below the sac. As this was not remediable, it was resected, and the healthy end was attached to the lower end of the hydronephrotic sac, as shown in Fig. 242. It will be noticed that the outer surface of the ureter is attached to the denuded inner surface of the sac.

FIG. 243. Abnormal position of ureter to hydronephrotic infundibulum of kidney before operation. (Morris.) The bougie could not be passed into the ureter through the kidney wound, therefore an incision was made in the pelvis.

The patient ultimately improved wonderfully in his general health and comfort. The fistula closed, although pus was present in the urine six months later.

Figures 244 and 245 illustrate a simple method of overcoming a valve or stricture at the junction of the ureter and pelvis. Simple lateral anastomosis also serves the same purpose. Fine catgut is the safest suture material. Silk may form the nucleus of a stone.

Morgan [1] has published a unique case of valvular obstruction situated about an inch and a half above the bladder. This malformation was probably due to kinking, which was again due to peri-ureteral adhesions, such as induce a similar condition in the œsophagus. Morgan divided the valve through an incision made extraperitoneally into the pouch. A suprapubic cystotomy was performed to pass catheters into the ureter to prevent recurrence and establish drainage. The patient ultimately made a good recovery.

[1] *Ann. of Surg.*, 1902, vol. xxxvi, p. 528.

III. STRICTURE OF THE URETER. Various plans have been adopted by different surgeons to remedy strictures of the ureter, the chief being the plastic method of Fenger,[1] dilatation by bougies (Alsberg), and resection of the strictured portion (Küster). The first of these plans only will be described here, as it will probably be found applicable to the greatest number of cases. Moreover, this method has been successfully carried out by Fenger, Morris, Mynter, and others.

The details of the operation can be very well made out by reference to the three illustrations in Fig. 246. The strictured portion of the ureter is
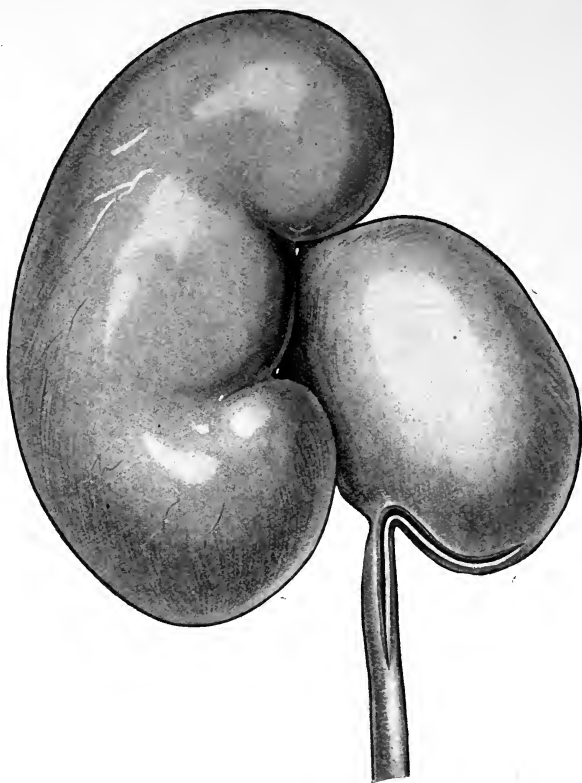
FIG. 244.

first divided longitudinally ; sutures of fine silk are then passed on either side of this in order to draw the two extremities of the incision together and thus convert it into a transverse one, after the manner of the Heineke-Mickulicz operation for stenosis of the pylorus. Further sutures, passing through the outer coats only, now bring the edges of the rest of the incision together, thus folding the ureter on itself to some extent.

The following short account of Fenger's case well illustrates the brilliant success of the operation :

" Traumatic stricture of ureter close to entrance into pelvis of kidney ; intermittent pyonephrosis for twenty-four years ; increased frequency of attacks ; nephrotomy ; no stone in sacculated kidney ; ureteral entrance could not be found ; longitudinal ureterotomy revealed stricture at

[1] *Loc. supra cit.*

upper end of ureter ; longitudinal division of stricture and plastic opera-
tion on ureter ; recovery without fistula."

Before performing any plastic operation upon the ureter or the
pelvis, it is very important to decide (a) if the kidney is in a recoverable
condition, and (b) if the ureter is patent throughout the rest of its
course up and down. Much may have been learnt about the functional
capacity of the kidney from an examination of the separated urines, but
the only reliable evidence is an examination of the kidney from the
wound. The patency of the ureter must be determined by means of a
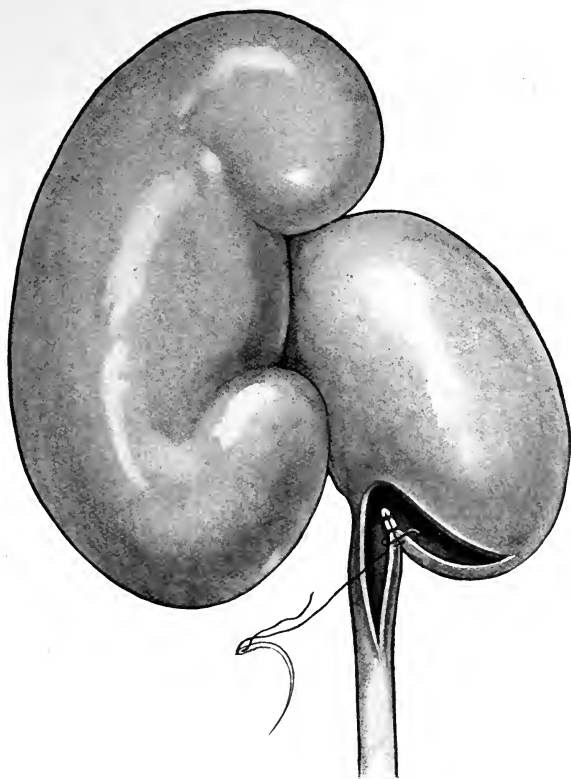
Fig. 245.

bougie or ureteral catheter. These must be used at the beginning of
all plastic operations, and before completing all nephro-lithotomies and
uretero-lithotomies. If these precautions are not taken the surgeon
may waste time and energy in performing useless operations, or fail to
relieve his patients by incomplete ones. It should be remembered that
stones and strictures of the ureter are often associated. The stone may
be either the result or the cause of the stricture. Carcinomatous stricture
may develop at or near an impacted stone.[1]

In cases of extensive or multiple strictures of the ureter, and in those
due to tuberculous or malignant disease, nephro-ureterectomy may be
the only suitable treatment if the other kidney is known to be sufficiently
healthy. Failing this, a fistula may be established in the loin.

[1] Deaver, *loc. cit.*

Ureteral catheterisation and dilatation through the bladder has been successfully performed, and cases have been published by Kelly, Pawlik, Casper, and others. Morris condemns the treatment as a difficult, tedious, and painful process, which is moreover uncertain and revolting. Pawlik had to pass the instrument thirty times in his cases of pyonephrosis. Symptoms of fever and pain may be aggravated by each introduction.

Strictures of the lower ureter may be approached through an extra-peritoneal abdominal incision and treated in one of various ways.

Young,[1] after removing a calculus impacted $1\frac{1}{2}$ cms. above the bladder, was able to dilate a stricture which had developed below the calculus. In another case of the same kind, Dr. Young removed a large calculus from
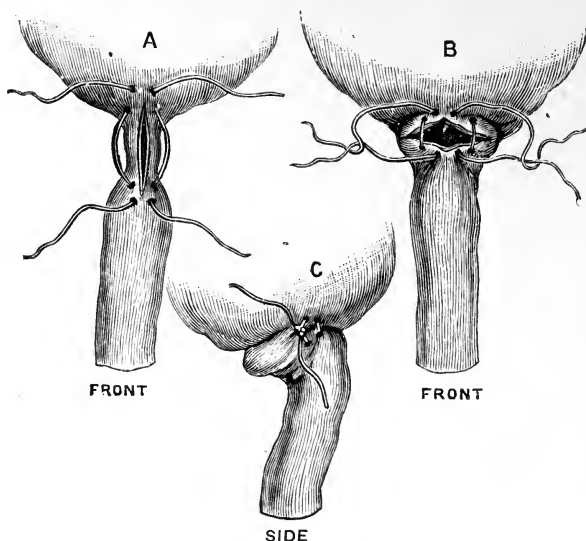
FIG. 246. Illustrating Fenger's operation for stricture of the ureter. (Morris.)

the ureter just above the wall of the bladder. He then discovered an impervious intra-mural stricture which he was not able to dilate. He therefore exposed the lateral wall of the bladder from the same iliac wound, and having retracted the vas deferens, he opened the bladder. With the aid of digital counter-pressure at the ureteral orifice, he was able to force the point of a small urethral dilator into the bladder and then to divide the stricture from within the bladder by means of a long-handled scalpel. The patient made a rapid recovery, and the ureteral orifice was seen to be patent six months later by means of the cystoscope.

Israel (quoted by Young) having performed a nephro-lithotomy on a woman, and discovered a stricture in the pelvic ureter, attempted to dilate the stricture from the bladder; but failing, he exposed the ureter extra-peritoneally, and found a stricture about 3 cms. long ending at the bladder wall. He then resected the stricture and joined the healthy end of the ureter to an incision made on a sound high up on the posterior wall of the bladder. The ureter was cut obliquely, and its mucous membrane sutured to that of the bladder at one angle of the wound,

[1] *Ann. of Surg.*, 1903, vol. xxxvii, p. 688.

which was then closed. The lumbar fistula, which had existed for eight months, soon closed. Before it closed Israel proved that fluid introduced into the bladder did not flow back through the new ureteral orifice, but a catheter could be passed from the fistula along the ureter into the bladder.

Extraperitoneal uretero-vesical anastomosis is far preferable to making a uretero vaginal fistula for the purpose of dilating the stricture, for the fistula may not close, and the stricture may recontract. Nephrectomy is better than a permanent urinary fistula either in the loin or vagina, if the other kidney is healthy.

Aberrant renal vessels crossing and obstructing the ureter may be ligatured and divided. Morris [1] discovered this condition in a woman whose symptoms had not been relieved by a nephropexy performed elsewhere four years earlier. Sixteen calculi were also discovered in the kidney, and were probably secondary to the ureteral obstruction. The writer has operated upon four patients suffering from this condition. One of these cases is quoted in full.

Miss H., aged 36, sent by Dr. Halstead of Ramsgate for a large swelling in the left side of the abdomen. The patient says that for five or six years she has had attacks of pain in the left loin and shooting down towards the groin. Sometimes the pain has been very severe and has only been relieved by morphia. No blood, pus, or small stone has ever been noticed in the urine. About two years ago a distinguished surgeon at Chester diagnosed movable kidney and ordered a kidney support, which has been worn ever since without much relief. During the pain a swelling appeared in the left loin, but this usually disappeared when the patient laid down. About a month ago a very severe attack developed and then a very large swelling appeared in the left flank, which hardly moved upon respiration and has not diminished since then. So large and so firm was it that it was at first thought to be a growth. The urine was normal. The swelling was mostly resonant in front and was thought to be a distended pelvis. An X-ray examination had failed to show any stone.

Operation on September 16, 1911. Dr. Fisk assisted and Dr. Halstead gave the anæsthetic. Before the anæsthetic an injection of two grains of indigo-carmine was made into the muscles of the right thigh and the cystoscope passed into the bladder containing three hours and a half urine, which only amounted to about four ounces. The two ureters were then watched. Nothing issued from the left ureter, but in about eight minutes pigment came away from the right. On further watching, at the end of twenty minutes nothing came from the left. The pigment did not come very rapidly from the right. The patient was then anæsthetised after the bladder had been emptied, and turned on the right side over a large kidney pillow. The usual incision in the loin was made and the kidney was found to be enormously enlarged. With some difficulty it was shelled from its surroundings and delivered into the wound, and then it was noticed that the obstruction to the ureter was due to the hooking of an artery extending into the lower pole of the kidney from the aorta in front of the beginning of the ureter, the pelvis having descended in front of this abnormal vessel. The obstruction was complete. The ureter itself was natural. On ligaturing and dividing the vessel the junction of the ureter and pelvis was seen to be natural and not narrowed, although there were some adhesions. With a little difficulty the urine was squeezed from the kidney to the bladder without incising the kidney or pelvis. The urine seemed clear as seen from the hugely distended pelvis. When the kidney had been quite emptied nephrorrhaphy was performed with four catgut sutures in the usual way. The kidney tissues seemed fairly good, although greatly expanded, and in view of the mobility and imperfection of the right kidney it was deemed inadvisable to remove a fairly good left. The wound was sewn up with mass salmon-gut sutures except at the hinder pole corner, where a tube was left. The patient was turned over, a catheter was passed, and sixteen ounces of clear, slightly blue-stained urine were withdrawn, most of which had been expressed from the left pelvis. The patient stood the operation well and made a good recovery, although there was some suppuration in the wound.

[1] *Lancet,* 1905, vol. ii, p. 158.

B. Injuries to the Ureter. These may be met with either in the form of traumatic ruptures, or of accidental division or removal of a piece of the ureter during the course of certain abdominal operations, such as hysterectomy or the removal of a pelvic tumour.

Traumatic rupture of the ureter has rarely been treated by direct suture. This is owing doubtless to the extreme difficulty in the diagnosis of this condition in the early stages, for most of the cases have not been recognised until an accumulation of urine, blood, or pus has formed and has been opened. The tumour due to the accumulation may not be noticed for some time, two to three weeks (Stanley, Page, Barker, Hicks), thirty-nine days (Croft), and in one case (Stanley's) not until seven weeks after the injury. The following is an interesting case successfully treated by early operation by the author.[1]

A youth, aged 18, was admitted into Guy's Hospital complaining of great pain in the left side of the abdomen. Two days before admission, whilst walking along the pavement with his left hand in his pocket, he fell on his left elbow, his hand being driven against the lower part of the abdomen, and causing an agonising pain shooting up to the left loin. Gradually a swelling appeared on the left side of the abdomen, and the patient was sick several times. On admission the temperature was 102, and pulse 110 to 120. The lower part of the abdomen moved but little on respiration ; the left iliac fossa was fuller and less resonant than natural, and very tender. If the local signs had been on the right side, his general and local condition would have agreed well with an attack of appendicitis. There was some tenderness and fulness in the left loin posteriorly. The bowels were constipated, the urine and the act of micturition were normal. The viscera were not transposed.

The abdomen was explored through the lower part of the left rectus. Some clear fluid escaped, but there was no septic peritonitis, and the appendix was normal. The retro-peritoneal tissue and the left meso-colon were very œdematous, with a greenish translucent appearance. The swelling extended up to the left kidney, which appeared to be normal in size and consistency. The abdomen was closed, and the patient was turned over on to his right side, and the left kidney was explored. On opening the perirenal tissue a good deal of slightly blood-stained fluid escaped. With some difficulty the kidney and the upper part of the ureter were isolated, and a clot of blood was seen plugging a large rent at the junction of the ureter and the renal pelvis inferiorly. The laceration extended nearly all the way round, a small part still remaining undivided at the upper and inner part of the tube. The clot had obstructed the lumen of the ureter. The rent was sutured with fine catgut in such a way that no narrowing of the lumen of the ureter resulted. This was not easy because of the depth of the wound, and the great amount of œdema of the surrounding tissues which kept flapping into the way. The loin was drained by means of a large cigarette drain, and the wound closed all round.

Although a ruptured ureter was suspected, the accident seemed to have been too trivial to produce such a severe injury, but, in the light of after events, it seemed clear that the left hand had impacted upon the ureter and pressed it inwards upon the pelvic brim, thus tearing the tube from the more or less fixed kidney. The situation of the rent at the lower and outer part of the junction of the renal pelvis and the ureter confirmed this view. The absence of hæmaturia and of all urinary symptoms, and the signs suggestive of local peritonitis in the left iliac fossa, added difficulties to the diagnosis and rendered an abdominal exploration necessary. A cystoscopic examination might have made this unnecessary, but no harm was done and but little delay caused by the preliminary exploration, which at once settled the diagnosis.

At first nearly all the urine escaped through the loin, and it was feared that another operation would become necessary ; but after about ten days a little pus appeared in the urine, and the amount of urine passed per urethram gradually increased. The sinus in the loin closed at the end of four weeks. The patient was able to return to work two and a half months after the accident, but occasionally a little pus appeared in the urine, and about six months later it was feared that a calculus had formed in the pelvis ; but an X-ray examination was negative and the symptoms subsided under treatment by urinary antiseptics. The patient was last seen about two years after the accident. He was then perfectly well and the urine was normal.

[1] Rowlands, *The Medical Press*, April 1909, p. 404.

Mr. Henry Morris [1] was only able to discover records of twelve cases of rupture of the ureter as distinguished from rupture of the renal pelvis. Should a traumatic rupture be discovered during an exploration, it should be treated by suture or anastomosis.

The accumulated fluid in the loin has been aspirated in some cases several times with ultimate recovery, but it is questionable whether the absence of reaccumulation has not been due to atrophy of the kidney.

Lumbar incision is far preferable, and thus drainage at least will be established to prevent further extravasation and suppuration. In some of these late cases it may be possible to perform a plastic operation on the ureter. If it be known that the opposite kidney is in good working order, a secondary nephrectomy may be performed for suppuration in and around the kidney, or for persistent fistula.
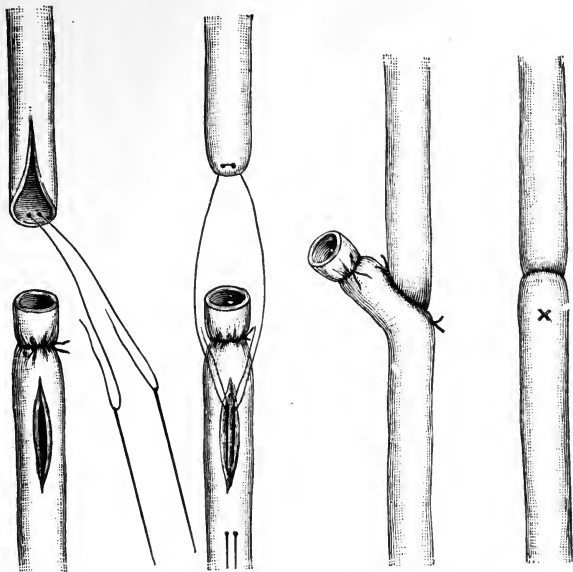
Fig. 247.   Uretero-ureterostomy : Van Hook's method.   (Morris.)

Primary nephrectomy is not justifiable, for the kidney and ureter may recover their functions, and knowledge is first needed concerning the secreting power of the other kidney, if any.

For accidental division or removal of a piece of the ureter during the course of an abdominal operation, a very large number of different operations have been performed. It is impossible here to mention or describe all these operations. An attempt will, however, be made to indicate the methods which are likely to be found most suitable to the various conditions that may be met with.

In the great majority of instances it will be found possible to directly unite the divided ends of the ureter. The results that have so far attended the various methods of bringing this about clearly show that it should be done wherever possible. Bovée [2] mentions twenty-seven published cases with only two deaths, and not in one was there failure to unite. If the ureter has been simply divided without loss of substance, and if both the ends are accessible, and the upper end will not reach the bladder,

[1] Vol. ii, p. 300.   [2] *Ann. of Surg.*, August 1900.

then, because it is the most simple method to carry out, and because it is the least likely to be followed by stricture, the following operation, devised by Van Hook (*see* Fig. 247), should be performed. The following are the steps of the operation as given by Fenger : [1]

"(1) Ligate the lower portion of the tube one-eighth or one-fourth of an inch from the free end. Silk or catgut may be used. Make with fine sharp-pointed scissors a longitudinal incision, twice as long as the diameter of the ureter, in the wall of the lower end, one-fourth of an inch below the ligature.

"(2) Make an incision with the scissors in the upper portion of the ureter, beginning at the open end of the duct and carrying it up one-fourth of an inch. This incision ensures the patency of the tube.
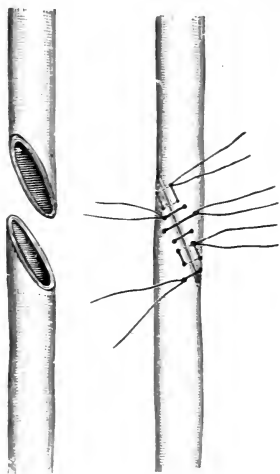
FIG. 248. Uretero-ureterostomy. To illustrate the oblique method of Bovée. (Morris.)
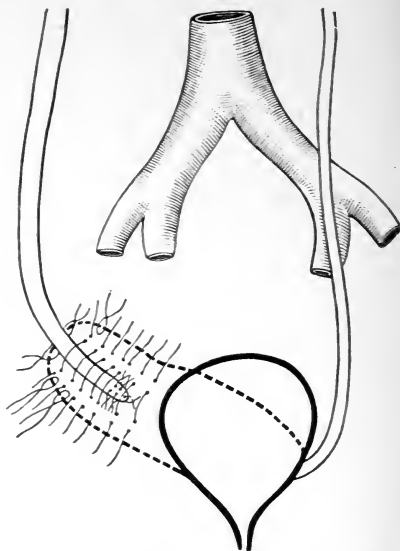
FIG. 249. Implantation of the ureter into the bladder (Witzel's method). The dotted line shows the bladder pulled into its new position with the ureter sutured into it. (Morris.)

"(3) Pass two very small cambric sewing needles armed with one thread of sterilised catgut through the wall of the upper end of the ureter, one-eighth of an inch from the extremity, from within outward, the needles being from one-sixteenth to one-eighth of an inch apart, and equidistant from the end of the duct. It will be seen that the loop of catgut between the needles firmly grasps the upper end of the ureter.

"(4) These needles are now carried through the slit in the side of the lower end of the ureter into and down the tube for one-half an inch, where they are pushed through the wall of the duct side by side.

"(5) It will now be seen that traction upon this catgut loop passing through the wall of the ureter will draw the upper fragment of the duct into the lower portion. This being done, the ends of the loop are tied together securely, and as the catgut will be absorbed in a few days, calculi do not form to obstruct the passage of the urine.

"(6) The ureter is now enveloped carefully with peritoneum."

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[1] *Loc. supra cit.*

If, however, a portion of the ureter has been accidentally removed, and the upper end will not reach the bladder, it will probably be found that there will not be sufficient length of ureter available for performing Van Hook's operation. In this case the ends must be united by end-to-end suture, or by the oblique method of Bovée (*see* Fig. 248). Stricture is not so likely to follow as after transverse end-to-end or end-in-end methods of Schopf and Poggi respectively.

Kelly [1] has used a hammer similar to the one introduced by Halstead for gall-duct operations. Near the end of the hammer there is a circular groove over which the distal end of the ureter is temporarily tied. This may be found useful in anastomosis of the lower ureter.
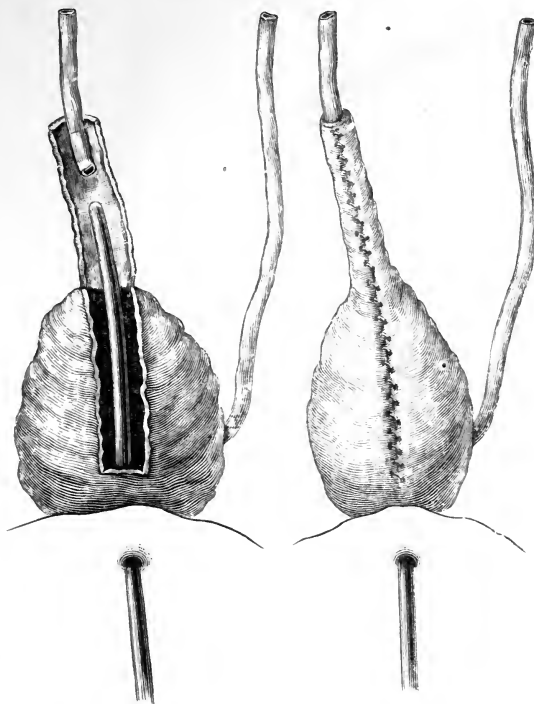
FIG. 250.   Boari's operation.   A flap from the anterior wall of the bladder is used as a substitute for the lower part of the ureter.   (Morris.)

Uretero-Vesical Grafting. Should it be found that the upper end of the divided ureter will reach the bladder, implantation into this organ is preferable to all other procedures. This may be carried out by some modification of the method of Paoli and Busachi,[2] which consists in splitting the distal end of the ureter and uniting it by sutures to an incision in the bladder, or by a modification of the operation of Van Hook for uretero-ureterostomy, the cut end of the ureter being invaginated into the bladder. This method has been adopted by Penrose and others.[3] If possible the operation should be performed extra-peritoneally as in Witzel's operation.[4] Witzel displaced and fixed the bladder into the iliac

[1] *Journ. Amer. Med. Assoc.*, October 6, 1900.
[2] *Annales des Maladies des Organes Genito-urinaires*, 1888.
[3] *Med. News*, vol. lxiv, 1894, p. 470.
[4] *Centralblatt für Gynakologie*, 1896, No. ii, p. 289.

fossa, in order to enable him to bury the ureter for a distance 4 cm. in the bladder wall as shown in the figure. The mucous membranes of the incision in the bladder and of the oblique opening in the ureter were joined with interrupted catgut sutures, and the external coats were also joined with sutures (*see* Fig. 249).

Resection of a growth of the bladder involving the ureteral orifice, makes it necessary to join the shortened ureter to the bladder from *within the latter*. Before the separated ureter is divided it is transfixed with catgut, which is used to secure it to the upper angle of the posterior vesical wound, which is then closed with catgut, except near the ureter, where a tube passes from the extra vesical tissues, through the anterior vesical wound to the surface. This tube serves a double purpose— drainage of the opened cellular tissues, and the maintenance of a free passage for the ureter. When the tube is removed and its track heals the contraction of scar tissue draws open the ureteral orifice. Stricture, the commonest cause of failure, is thus avoided, as shown by the cystoscope months later (Thompson Walker).

Boari [1] has described and figured an ingenious plan of raising an extra-peritoneal flap from the anterior wall of the bladder and joining its edges, and implanting the ureter into the tube thus formed. This method may be found useful when displacement of the bladder is not enough to allow of union without tension. Van Hook has described a similar method ; the ureter had been previously implanted upon the skin of the abdomen.

Finally, should such a length of ureter have been removed as to render both direct union of the two ends and implantation into the bladder impossible, the proximal end must be either implanted into the bowel or on the skin. The results of both these plans have so far been on the whole extremely unsatisfactory, owing to infection of the ureter and kidney in the case of implantation into the bowel, and to discomfort and constant irritation of the skin when the implantation is made on the skin. For these reasons a secondary nephrectomy will often be necessary in such cases.

[1] *Loc. cit.*

CHAPTER XXXII

OPERATIONS UPON THE BLADDER

RUPTURE OF THE BLADDER

THIS used to be a most fatal accident, thus out of 143 cases of intra-peritoneal rupture collected by Ullmann in 1886, only 2 recovered; and only 20 out of 94 cases of extra-peritoneal laceration got well.[1]

The late Sir William MacCormac was the first to publish two successful operations for intra-peritoneal rupture.[2]   Many successful operations have been recorded since then.   Alexander [3] and Jones [4] collected 45 cases of intra-peritoneal rupture, with a mortality of 63·5 per cent. after 32 operations before 1893, and 27·5 per cent. after 22 operations performed since 1893.

Ashhurst [5] has collected 110 cases with 63 recoveries, and 47 deaths, a death-rate of 42·72 per cent.

Quick [6] adds to Jones's 22 cases, treated since 1893, 7 more recent ones, and out of these 29, only 7 died, a mortality of 24·1 per cent.   These figures are probably too favourable, for successes are generally published, whereas the more instructive failures are too often forgotten.

Exploratory operations and suture of the bladder will be increasingly successful in favourable cases, *i.e.* those seen early and those in which the injury is limited to the bladder.

Two forms of rupture are recognised—the intra- and extra-peritoneal, but, in some cases, the tear extends to both the intra- and the extra-peritoneal surfaces, and occasionally two lacerations may co-exist, and one of them is very likely to be overlooked.   It may be well to state succinctly the symptoms.

Intra-peritoneal Rupture.   (1) History of a likely injury.   (2) Inability to pass water.[7]   This power has, however, been preserved in both varieties :   naturally it is seen most frequently and more completely in extra-peritoneal cases.   It is very rarely normal in the intra-peritoneal ruptures.   Attempts at micturition may be frequent and painful, but only blood-stained fluid may be voided in small quantities. (3) A little bloody urine drawn off with a catheter.   (4) Difficulty of manipulating an instrument in a contracted bladder.   (5) If the catheter, hitting off the rent, be passed beyond the bladder, a much larger quantity of blood-stained fluid is withdrawn, partly urine, partly serum, from irritation of the peritoneum.   If the flow through the catheter is

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[1] Von Bergmann, vol. v, p. 452.   [2] *Lancet*, 1886, vol. ii, p. 118.
[3] *Ann. of Surg.*, 1901, vol. xxxiv, p. 209.   [4] *Ibid.*, 1903, vol. xxxvii, p. 215.
[5] *Amer. Journ. Med. Sci.*, July 1906.   [6] *Loc. supra cit.*
[7] Thus the rent may be valvular or blocked by intestine, &c.   On all these and many other points the reader should refer to Mr. Rivington's writings, *Dict. of Surg.*, vol. i, p. 152, and *Rupture of the Urinary Bladder*, for exhaustive completenesss and helpful information.

markedly increased by inspiration and diminished by expiration, the rent is probably a large one.

(6) Shock. This may be absent or pass unnoticed in patients who are intoxicated at the time of the accident, and as the laceration frequently occurs under these circumstances, this fact is important to bear in mind.

This form of rupture commonly follows a kick or a blow upon the abdomen, when the bladder is distended, but it has also occurred spontaneously during the retention of urine from stricture, enlargement of the prostate, or any other obstruction. The accident has also occurred during the crushing of vesical stones and in the course of perineal operations upon the bladder; Bottini's galvano-cautery has opened the peritoneum a good many times during the attempt to cauterise the enlarged prostate in the dark.

(7) Speedy supervention of signs of peritoneal irritation, viz. pain in the lower part of the abdomen, tenderness and rigidity. The surgeon should not wait for the classical signs of peritonitis to manifest themselves. Dr. Quick records a case in which no peritonitis had developed after 10½ days. The patient, who was intoxicated at the time of the accident, was able to work on the following day, but he had to leave off on the second day on account of pain and vomiting. He recovered after an operation, performed on the eleventh day by Dr. G. F. Thompson.[1]

In other cases, in which the urine has been aseptic and no instruments have been passed, the onset of peritonitis has been considerably delayed.

(8) Perhaps fluctuation and shifting dulness in the flanks, with abdominal distension.

Extra-peritoneal Rupture. This is often due to or associated with fracture of the pelvis, but it frequently happens when no such fracture exists. It has followed repeated suprapubic aspiration. (1) History of a likely injury. (2) Difficulty in passing water (*vide supra*). (3) Bloody urine drawn off. (4) The catheter finds the bladder contracted. (5) No tapping of a larger amount of fluid. (6) Evidence of extravasation rather than of peritonitis. Thus, if the rent is in front, the urine may be localised there with circumscribed dulness; or widely diffused, mounting up towards the umbilicus, between the abdominal muscles and the peritoneum; or passing into the iliac fossæ, or, by the canals, into the scrotum and thighs. In one case that I saw the extravasation was much more extensive upon the right side so that the situation of the rent was correctly diagnosed to be upon this side. In another patient, the late Mr. Davies-Colley localised the position of the extra-peritoneal rent, which was due to a fracture of the pelvis, by the inability of the boy to flex and adduct his right thigh; vertical fractures through the right rami were found at the operation. The patient soon becomes very ill, with a quick pulse and respiration, probably from reabsorption of urine from the connective tissue; these symptoms appear while the extravasation is still sterile, but sooner or later infection is bound to follow.

It must be remembered that the following may mislead : There may be very little pain complained of; no sickness; a normal temperature; the patient may be able to walk; upwards of half a pint of urine may be drawn off night and morning, and yet the peritoneal sac may contain much fluid. Peritonitis may be absent post-mortem, though tympanites be present during life, and though fluid be found in the

[1] *Ann. of Surg.*, January 1907, p. 94.

peritoneal sac. The patient may live as long as five days, apparently improving, and then die suddenly.

The following may be useful in doubtful cases :

Mr. Walsham in his second case,[1] to make certain of the existence of a rupture, made use of the injection of air, the injection of fluid not being conclusive. " For this purpose the india-rubber apparatus belonging to an ether-freezing microtome was utilised, the tube of which was attached to the free end of the catheter. The liver dulness having been carefully percussed out, a few cubic inches of air were forced through the catheter by two or three contractions of the rubber ball. The effect was instantaneous. The abdominal cavity became distended, the liver dulness immediately effaced, and the whole abdomen tympanitic to percussion. The patient fell into a condition closely resembling collapse ; he complained of great pain, his respiration was laboured, and the action of the heart turbulent."

This method was recommended independently by two American surgeons, Dr. Morton and Professor Keen, in 1890. Mr. Walsham was the first to employ it. The cystoscope is not likely to be of much use except in the extra-peritoneal injuries, owing to the difficulty of keeping fluid within the bladder with intra-peritoneal ruptures.

Operation. This must be undertaken without delay. A free incision five or six inches long in the adult, is made near the middle line. The rectus sheath having been divided, the rectus drawn outwards and partly detached if needful, all bleeding-points secured, the lower angle of the wound and the parts behind the pubes are carefully examined for ecchymosis, extravasation, &c. If neither of these nor any collection of fluid is found outside the peritoneum, this is opened, when a large gush of fluid may be decisive. The surgeon now introduces his left hand to feel for the rent, and the detection of this may be facilitated by passing a sound. The rent will vary in site and length, and also as to regularity, thickening, &c. If it be a long one, and reach downwards towards the recto-vesical cul-de-sac, the Trendelenberg position should be adopted. This gives valuable assistance, for it grants a good view of the posterior surface and affords plenty of room for the introduction of sutures without risk of injuring the small intestines, which fall away and are protected with a sterile pad. A self-retaining retractor is inserted. An assistant may render service at this time by grasping the upper end of the bladder and drawing it forwards and a little to one side. The rent, being now in view, is cleansed, and a continuous perforating catgut suture is inserted with a short curved needle and a good needle-holder, owing to the depth of the wound and the limited space there is to work n.

The catgut should be strong and tanned to last about 21 days. The sewing is begun at the front end of the rent. The tail thread is held up by the assistant, who holds the bladder well up in this way and facilitates the closing of the postero-inferior part of the laceration. A continuous Cushing sero-muscular suture of fine linen thread now reinforces and buries the perforating catgut suture (*see* Fig. 264). The gauze packs are removed, the pelvis is cleansed and the abdomen is closed in layers ; but when there is peritonitis a temporary drain is left at the lower angle of the wound, with its deep end well away from the bladder. A drain should be left in the prevesical space in extra-peritoneal ruptures, especially

[1] *Trans. Med.-Chir. Soc.*, vol. lxxviii, p. 278.

if the operation has been deferred until it is difficult or impossible to find or suture the rent satisfactorily. As a rule a catheter should be tied in, care being taken not to pass too much of it into the bladder, but to leave the eye only just above the vesical orifice. The bladder must not be allowed to get full, either from slipping or blocking of the catheter. In some early cases under constant observation, after accurate sewing, the patient may be left to void his own urine frequently or a catheter may be passed every four hours.

Cases occasionally occur where the neck and not the body of the bladder is lacerated, a fracture of the pelvis perhaps co-existing. Where there is inability to pass water and where, failing the cystoscope, it is uncertain whether a catheter enters the bladder, it will be best to explore the front and neck of the bladder by a supra-pubic incision not opening the peritoneum. If blood-stained fluid well up, and if the catheter be detected lying outside a full bladder, the latter should be opened and drained supra-pubically to prevent any further escape of urine. The pelvic cellular tissues should be drained by the same route and sometimes perineally also.

In late cases with pelvic cellulitis free incisions must be made and drainage established.

Causes of Death. Peritonitis, shock, hæmorrhage, cellulitis.

Peritonitis is far the commonest cause of death, and it may be due to infection from previously infected urine, or from careless instrumentation, from infection at the operation or subsequent leakage due to inefficient suturing.

TEMPORARY SUPRAPUBIC DRAINAGE

The following methods will be considered here :

(i) **Aspiration.**

(ii) **Suprapubic Puncture.**

(i) **Aspiration.** This may be used in cases of great urgency, when the surgeon is compelled to relieve retention without regard to the cause, when he is without the means of carrying out other and perhaps better methods ; it is especially suited to those cases in which there is reason to believe that urine will again, in a few hours, be passed by the urethra, either naturally or through a catheter. Thus in gonorrhœal retention, where a catheter cannot be passed, having perhaps been clumsily used, and where relief is urgently required, where retention has supervened on a stricture of only two or three years' standing, this means may be used successfully, giving time for warm baths and opium to act. In an old stricture, in one of traumatic origin, or in a case of enlarged prostrate, it can only confer temporary relief, and should be used only when other methods are not available.

The question arises, *How far will aspiration bear repetition?* This is quite uncertain. On the one hand, in a case of prostatic retention not admitting a catheter, the patient being throughout in a most grave condition, Dr. Brown [1] used the aspirator fifteen times between January 2 and 12, " with immediate relief on every occasion, and without the smallest inconvenience or injury from the punctures." Mr. Hague,[2] in a patient aged 90, with prostatic retention of forty-eight hours' duration, aspirated, and continued to do so daily for nearly five weeks, as no catheter could be passed. Such numerous aspirations caused no ill effects.

On the other hand, in a case of Mr. Jacobson's of prostatic retention in which the aspirator had been used only three times, on the death of the patient from bronchitis

[1] *Brit. Med. Journ.*, May 23, 1874.   [2] *Lancet*, 1885, vol. ii, p. 385.

on the fourth day the third and last puncture was found to be leaking.   Dr. Campbell[1] records a case in which the bladder had been aspirated twice, and internal urethrotomy then performed.   " Progress was good for a day or two, when some inflammation appeared at one of the punctures, an abscess formed, peritonitis came on, and the man died."   Where aspiration is to be used, the condition of the bladder walls and of the urine must be taken into account.[2]

If aspiration be made use of, a fine needle should be employed, and introduced just above the pubes while an assistant steadies the bladder by pressure on either side.   The bladder must not be allowed to become much distended before the puncture is repeated, otherwise urine may be forced out.
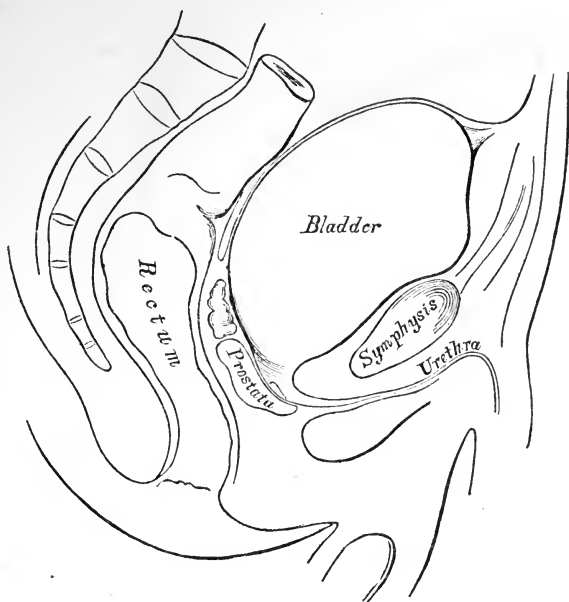
Fig. 251.   Sagittal median frozen section of the pelvis, the bladder being distended.   (C. Langer.)

(ii) **Suprapubic Puncture.** This   operation   has   the   *advantages* of being easily performed, of giving permanent relief if desired, and of being safe.

The two *objections* brought against it are—that (1) it gives bad drainage, and (2) it is liable to extravasation.[3]   Neither of these is borne out by facts.   While the patient is in bed, good drainage can be provided by turning him on one side and attaching tubing to the cannula ;   when the patient is up (and a cannula so placed is no drawback to this), the power of micturition will probably have returned. In rare cases of enlarged prostrate where a radical operation is declined,

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[1] *Brit. Med. Journ.*, February 21, 1886.

[2] Mr. Bennett read a case before the Medico-Chirurgical Society (*Lancet*, 1888, vol. i, p. 418) of extra-peritoneal rupture of the bladder after aspiration in a patient long the subject of stricture.   The opinion of most surgeons present seemed to be that aspiration was dangerously liable to leakage, especially in unhealthy bladders.

[3] Mr. T. Smith (*St. Barthol. Hosp. Reports*, vol. xvii, p. 291) writes : " I have seen no such tendency to extravasation ; occasionally there is some inconvenience from leakage : this may be met by leaving out the cannula for a few hours, which allows recontraction to take place."

the patient will be compelled to pass his urine this way for the rest of his life, but as soon as the parts are consolidated around the cannula, or the catheter which has replaced the cannula, micturition, though tedious, will be effected satisfactorily.

I may allude to three cases out of many in which I have used this method, two of retention with stricture, one of prostatic retention. I consider it the best all-round method, and the one of widest application that we have. Its relief is immediate, safe, and simple withal. The two cases of stricture were men under 40, admitted with a history of catheterism, bleeding urethræ, and recent false passages. On the fifth and second days I was able to pass a No. 7 silver, and in the third case a coudée, catheter. For some cases of older strictures, especially if with fistulæ and a damaged perineum, a longer rest is required, and Mr. Cock's or Mr. Wheelhouse's operation is indicated.

Operation. This is most simple, and eucaine or novocaine ($\mathfrak{M}$xx-$\mathcal{3}$j of a 2 per cent. solution) can be injected into the skin. A median puncture having been made with the knife through the skin just above the shaved pubes, the trocar is pushed backwards and a little downwards until it is felt to enter the cavity of the bladder. I prefer a curved trocar and cannula, the latter carrying tape-holes, but a straight trocar and cannula may be used, through which a rubber or silk web catheter is threaded. When the point is well in the bladder the cannula is slipped out while the catheter is steadied. To prevent the patient from pulling it out I always sew it to the skin. A long rubber tube is affixed to the catheter by means of an intervening glass tube, and the urine is thus conducted to the bottom of a vessel on the floor filled with antiseptic solution. In this way syphonage is obtained.

PERMANENT SUPRAPUBIC DRAINAGE

This may be required for irremovable malignant growths of the bladder or prostate, and has been adopted for enlargement of the prostate in very feeble old men, when a catheter cannot be used, as the risk of a radical operation is not accepted.

A soft rubber catheter (No. 12) is inserted in the suprapubic fistula, so that its end projects about two inches into the bladder. This is held in position and leakage prevented by means of a silver plate, accurately fitted to the suprapubic region and kept in position by a belt. The rubber catheter when stretched passes through the tube attached to the plate, but when relaxed it fits accurately, so that no urine runs away by its side. When the suprapubic sinus dilates so that some urine leaks by the side of the catheter, the latter is left out for a night to allow the fistula to contract a little. Similarly, a self-retaining rubber catheter with rubber flange and belt can be used. The urine is conducted to a rubber urinal attached to the thigh.

SUPRAPUBIC CYSTOTOMY

This operation may be required for exploration, drainage of the bladder, for the removal of stones, foreign bodies or growths from the bladder, for the treatment of ulceration of the bladder, or for removal of the prostate.

Exploration per se is rarely necessary at the present time owing to the development and skilful use of the cystoscope.

Drainage is sometimes necessary as a temporary measure for :

(1) Severe cystitis especially in feeble old men and in the presence of obstruction of the urethra ; when the pain is intense and micturition taking place every few minutes with strangury, causing insomnia ; when there is high temperature and other evidence of imminent septicæmia ; when all other treatment has failed, and washing out is insufficient, unendurable or impossible.

The operation here, for the sake of the kidneys, must not be put off until too late. Much benefit may be obtained by irrigation and by the application of weak solutions of nitrate of silver.
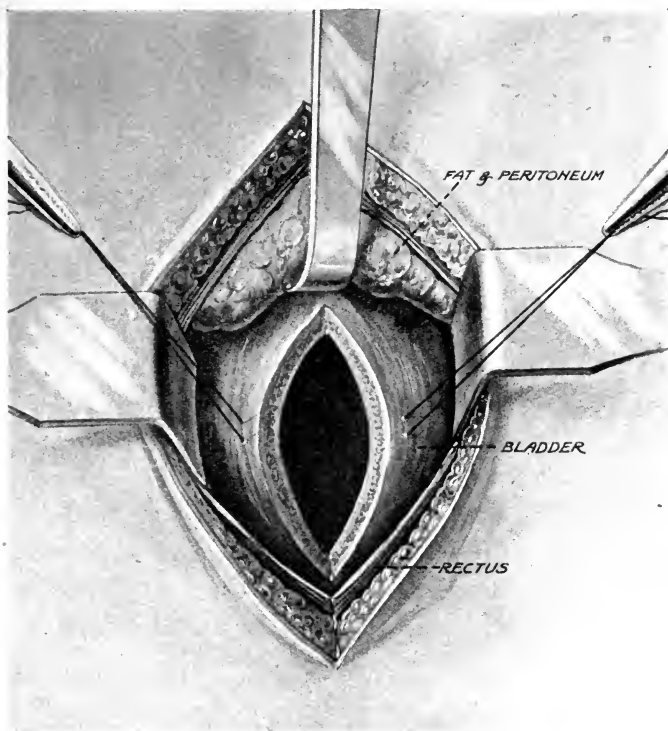
Fig. 252. Suprapubic cystotomy. The peritoneum and subperitoneum fat are drawn up. The bladder is held forward by sutures.

When the cystitis is relieved and the patient is stronger, a suitable radical operation such as prostatectomy may be performed.

(2) Rarely for late tuberculous cystitis.

(3) As an aid to other operations. Thus before plastic operations upon the urethra to keep the parts dry and aseptic, the bladder may be drained above the pubis. Mr. Jacobson did this in a case of epispadias. I should prefer suprapubic puncture with syphonage.

For the removal of stones, this operation has been properly replaced to a great extent by crushing, but large stones still require cystotomy, and some surgeons prefer this operation to crushing for smaller stones, especially in children.

Operation. When the patient is anæsthetised,[1] a soft catheter is passed, the bladder is washed out, and filled with warm boracic lotion or sterilised water until its outline can be seen or felt above the pubis. Either a tube and funnel or a bladder syringe of 5 oz.-capacity can be used. Usually about 12 oz. of boracic lotion can be retained without harm, but when the bladder is small, it is safer to defer the full distension until the suprapubic incision is made. Then the bladder projects into the wound as it is distended. The full syringe is left with its conical nozzle plugging the funnel end of the catheter ready for use if necessary. A vertical incision is made in the middle line extending upwards from the pubis for four inches. The rectus sheath is opened for three inches, the muscle fibres are separated, and the thin fascia transversalis is incised close to the pubis. With the left index finger the subperitoneal fat and peritoneum are displaced upwards out of the way until the bladder is displayed, and recognised by its muscle fibres and large veins. The margins of the wound are protected with enveloping pads, and the knife is plunged into the bladder about an inch and a half above the pubis, making a small vertical incision. As the knife is withdrawn and water rushes out, the left fore-finger is introduced into the bladder to hold it forwards and explore its interior. The escaping liquid is meanwhile soaked up with gauze. As the bladder empties its whole interior and the upper part of the urethra can be examined. If it is necessary to do anything beyond draining the bladder the incision is enlarged to the required degree, mostly by stretching with the fingers in order to avoid bleeding. A stone or foreign body is extracted with scoop or forceps.

If it is necessary to see the whole interior of the bladder or to remove a new growth or ulcer from the lower part, the Trendelenberg position is always adopted, for the intestines gravitate towards the diaphragm and atmospheric pressure drives the posterior wall of the bladder upwards, so that an infinitely better view is obtained. Good retractors and a fore-head lamp now enable the surgeon to see all the mucous membrane after the blood-stained liquid has been mopped up with dry gauze. Towards the end of the operation the question of drainage will arise. If the urine be clean, the renal function good, and there be neither obstruction of the urethra or bleeding going on within the bladder, (a) *the latter is completely closed* with two continuous catgut sutures, which are threaded on curved round needles. The catgut should be of medium thickness and hardened to resist absorption for about three weeks. The deep suture pierces all the coats of the bladder and is introduced after Connell's method, inverting the edges of the wound. The reinforcing suture does not pierce the mucosa (*see* Fig. 253). A small rubber tube containing a mere wick of gauze is placed at the lower angle of the wound to drain the prevesical space for thirty-six hours; otherwise the wound is closed with catgut for the rectus sheath and salmon-gut sutures, including the rectus sheath and the skin. A large soft catheter is tied in for four or five days; and washed through if it gets blocked with clot at any time. When the catheter has been removed the patient is encouraged to pass his water regularly every two hours to prevent over distension for a few days until the wound is soundly healed.

[1] Spinal anæsthesia is most valuable when relaxation of muscle is essential.

(b) *Drainage is adopted* when there is considerable cystitis or oozing of blood, or prostatectomy has been performed.

The simplest way is to introduce into the vesical wound a large rubber tube three quarters of an inch in diameter with two side openings near its inner end, and fix it with a catgut suture piercing the tube and the muscular coat of the bladder. If the tube is not gripped by the contracted wall of the bladder, inverting sutures are inserted until the tube fits snugly. A gauze wick is placed in the prevesical space just below the rubber tube, and the parietal wound is closed around the tube. The tube
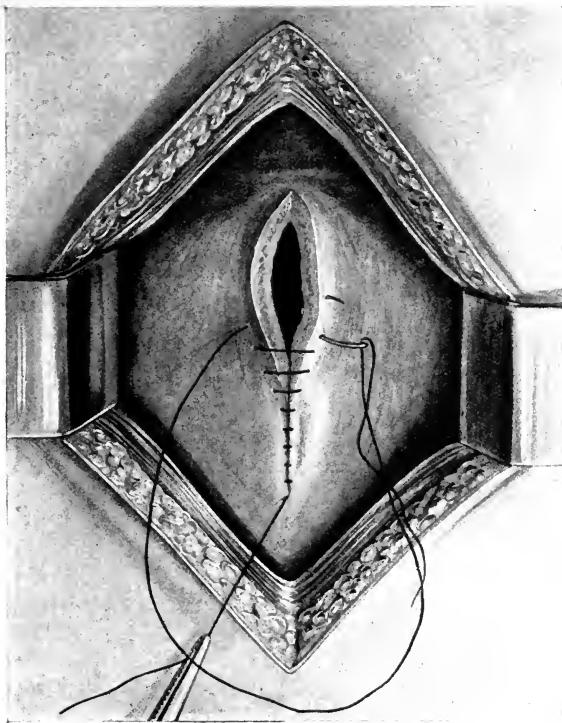
Fig. 253. Suprapubic cystotomy. The Connell suture is shown. This is reinforced by a Cushing suture.

is secured in position with a suture to the skin on either side. The tube extends an inch into the interior of the bladder, and projects an inch above the skin. To its outer end a long piece of thin rubber tubing is attached to conduct the urine into a receptacle under the bed.

The bladder is washed out once, or even twice, a day at first, with warm boracic lotion; for this a rubber tube attached to a funnel is introduced well into the bladder through the large suprapubic tube, and thus clots and débris are dislodged. The patient is turned on his side, so that the issuing stream runs into a dish. Unless prolonged drainage is required the tube is generally removed at the end of three days.

The irrigation tube or catheter is then introduced through the suprapubic wound; and when this is impracticable the catheter is introduced

through the urethra if irrigation is still required. After the tube has been removed various methods of keeping the patient dry may be tried, especially the Cathcart or White suction apparatus, or the Colt or Irving systems of collecting the urine as it issues above the pubis. The wound, however, keeps cleaner and heals better without any apparatus. It is simply dressed with antiseptic gauze, a wick of which dips a little way into the fistula. This is covered with a thin layer of sterile cotton wool and large pads of cellulose wadding are arranged around the pelvis. If the fistula is slow in closing a catheter is tied in the urethra for a few days.

CHAPTER XXXIII

REMOVAL OF GROWTHS OF THE BLADDER

Chief Varieties.
(1) *Epithelial Tumours.*
   (*a*) Papilloma : (i) fimbriated papilloma or villous growth, often
       pedunculated ; (ii) fibro-papilloma, which is sessile and
       almost smooth on the surface as seen with the naked eye.
   (*b*) Carcinoma : (*a*) villous or cauliflower variety ; (*b*) flat-
       tened ulcerative and infiltrating variety.
   (*c*) Adenoma—*a very rare growth.*
   (*d*) Dermoids : (*a*) pigmented hairy patches, *very rare* with
       sebaceous and sweat glands ; (*b*) dermoid cysts.
(2) *Connective Tissue Tumours.*
   (*a*) Fibroma.
   (*b*) Myxoma.
   (*c*) Sarcoma.
   (*d*) Myoma.
   (*e*) Angioma.

By far the most common growths are (1) Simple villous papilloma ;
(2) Malignant villous papilloma ; and (3) Carcinoma.

All connective tissue tumours are uncommon, but myxoma and
sarcoma sometimes occur, especially in children. Phleboliths may form
in a nævus, and these are very puzzling when shown by radiography.

Epithelial tumours are by far the commonest, and they are found chiefly
during middle age and especially in men. The large majority spring
from the neighbourhood of the trigone, especially near the ureteral orifices.

All papillomata are potentially malignant. When the epithelium begins
to invade the connective tissues of the bladder the growth is becoming
malignant ; but it is not at all easy to tell, either with the naked eye,
the cystoscope, or even with the microscope, whether any given villous
tumour is innocent or malignant, for the one merges into the other,
without any sharp line of demarcation. Growths from neighbouring
tissues may invade the bladder, especially from the prostate and rectum,
and dermoid and hydatid cysts in the pelvis, sometimes burst into the
bladder.

Carcinoma springs from the lower zone of the bladder in 60 per cent.,
from the middle zone in 30 per cent., and from the upper zone in 10 per
cent. (Fenwick). The most favourable carcinoma is the hard flat variety
and the most favourable site for resection is the upper zone.

Practical Points in the Diagnosis. Early and accurate diagnosis is
here of the utmost importance.

(1) *Hæmorrhage.* This is of much importance both in diagnosis
and in its bearing upon an operation. Symptomless hæmaturia of

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vesical origin is very characteristic of growth of the bladder. Sir Henry Thompson laid much stress on the fact that, in these cases, the stream often begins without any or with little blood, and ends of a bright red colour. Pure blood may be expressed by the final efforts of the bladder as it closes upon and compresses the growth. Bleeding forms the initial symptom in a large number of cases, especially when the growth is of the villous type. Mr. Hurry Fenwick [1] states that hæmaturia is the first sign in about 84 per cent. of benign papillomata, and in about 75 per cent. of the cases of villous carcinoma, and about 60 per cent. of the bald malignant growths.

In villous growth or fimbriated papilloma hæmorrhage alone may kill, and it may be the only symptom throughout. In these growths the chief point is that the hæmorrhage extends over a long time,[2] occurs spontaneously and suddenly, and without any allied symptoms; it ceases in the same way; the periods of intermission gradually become less, till the bleeding is constant, either rendering the patients utterly anæmic or adding to their misery by bringing about cystitis. These two last conditions may be so marked as to demand an operation. This symptom is most frequent in the villous growth (fimbriated papilloma), less so in the fibro-papilloma or in the " transitional " growths. In the flat carcinomatous or epitheliomatous growths hæmaturia is more frequently associated with other symptoms and it is less profuse; but repeated small hæmorrhages with only short, if any, intermissions, occur and exhaust the strength of the patient; and the blood is often dark from decomposition and is more diffused throughout the urine.

(2) *Sudden arrest of the Stream of Urine.* M. Guyon [3] points out that in a few cases a pedunculated growth situated near the neck may cause obstruction and other troubles, before hæmorrhage appears.

Mr. Hurry Fenwick estimates that sudden arrest of the stream occurs as the initial symptom in about 8 per cent. of the benign villous, and about 10 per cent. of the malignant villous growths: whereas it is very rarely noticed with the flat or bald variety of carcinoma.

Any tumour which grows quite near or infiltrates the tissues around the urethral orifice of the bladder may cause obstruction to the flow of urine sooner or later, and this may simulate carcinoma or even senile enlargement of the prostate. The writer removed suprapubically a villous growth which had prolapsed into the prostatic urethra causing hæmorrhage with complete retention of urine. The growth was firmly gripped and gangrenous.

(3) *Unilateral Renal Pain.* Growths are so very frequently situated at or quite near to one or other ureteral orifice, that they often obstruct it either by dragging, or compression from infiltration. Hence dilatation of the ureter and renal pelvis or pyelitis may develop and cause pain in the corresponding loin.

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[1] *Tumours of the Urinary Bladder.*

[2] Mr. R. Harrison (*Intern. Encycl. Surg.*, vol. vi, p. 38) states that in the Museum of St. George's Hospital there is a specimen of a villous tumour attached to the neck of the bladder of a gentleman aged 81. The first attack of hæmorrhage had occurred twenty years before death, and had lasted for eight months. An interval of four years had followed this, and then a recurrence of hæmorrhage, which ultimately proved fatal. Sir B. Brodie also states that the disease occasionally extends over seven or eight years. In a case of the late Mr. W. Anderson's (*Clin. Soc. Trans.*, vol. xviii, p. 313), of papilloma, the first hæmaturia had taken place twelve years before, then came an interval of a year, followed by recurrence of the hæmaturia, the next interval being shortened to six months, after which recurrence took place fairly regularly every three months.

[3] *Ann. de Mal. des Org. Gén.-Urin.*, 1889, p. 449.

This may be the initial symptom of vesical growth occasionally, and the kidney has been needlessly explored in some cases under these circumstances. This symptom, which may serve to localise the growth, is noticed earlier with benign papilloma than with villous carcinoma, which obstructs by infiltration around the ureteral end.

(4) *Frequency of Micturition* and other symptoms of vesical irritation are most frequently associated with the infiltrating flat growths, and they are least common with benign villous tumours. Fenwick estimates that these symptoms are the initial ones in about 30 per cent. of the bald carcinomata, 15 per cent. of the villous carcinomata, and only 8 per cent. of the simple villous papillomata. Pain is more frequent and most severe with infiltrating carcinoma.

(5) *Examination of the Urine.* This aid has been too much neglected because the naturally present " transitional " epithelium of the bladder may so easily be mistaken for growth cells. But, in the case of villous growths especially, careful examination of the urine should be frequently made, and the patients directed to bring, at once, any white or shreddy particles passed. The delicate papillæ, with their connective-tissue basis supporting hosts of columnar cells with large delicate capillaries, are most characteristic. Recognisable fragments are more rarely cast off the malignant villous growths, and when any are found, they give no indication of the nature of the base of the tumour; the villi may be innocent in appearance, and yet the base may be malignant. It is uncommon for the bald or flat growths to shed any pieces until the late sloughy stage, but when seen microscopically, the fragments are characteristic enough. It is very important to ascertain the total amount of urea passed in the 24 hours, for if the excretion is seriously lowered, no operation should be undertaken on account of the danger of death from uræmia. Marked wasting is very characteristic of malignant disease of the bladder.

(6) *Rectal Examination.* This should never be omitted, for with the bladder empty of urine, the finger may detect a thickening, hardness or rigidity of the base above the prostate, indicating an infiltrating growth. Usually the mass is separate from the prostate, but in late cases the latter may not be distinct from the growth. A benign growth cannot be felt per rectum, and the villous carcinoma may only indicate its presence by an unusual fulness or heaviness of the bladder, but a carcinoma which infiltrates the vesical wall soon becomes palpable, and Fenwick states that quite 50 per cent. of these growths are palpable per rectum, within a year of their origin. A rectal examination may thus enable the surgeon to dispense with cystoscopic or other examinations of the interior of the bladder, for in these cases an operation is nearly always futile, and a mere cystoscopic examination is not free of danger in them. The patient should be examined in the kneeling attitude as well as in the supine position, for the former posture enables the surgeon to feel higher up the posterior wall of the bladder. Bimanual examination with the patient supine, and the abdominal wall relaxed, may discover infiltrating growths placed in unusual positions such as at the fundus or on the anterior wall. In the female vaginal examination should be conducted in a similar way.

At the present day it is quite unnecessary and unjustifiable to sound any patient suffering from hæmaturia only, for a stone is extremely unlikely to be the cause, and to try to detach pieces of growth for

examination is foolish. When this method was used before the days of the cystoscope, it often failed in its purpose, and seriously aggravated the hæmorrhage, and not uncommonly it was followed by cystitis, even when all care had been taken in ensuring asepsis.

(7) *The Cystoscope.* In skilful hands the cystoscope is of the greatest value in the detection and examination of vesical growths, and it enables the surgeon to decide for or against an operation.

Carcinomatous growth

Rod in ureteral orifice
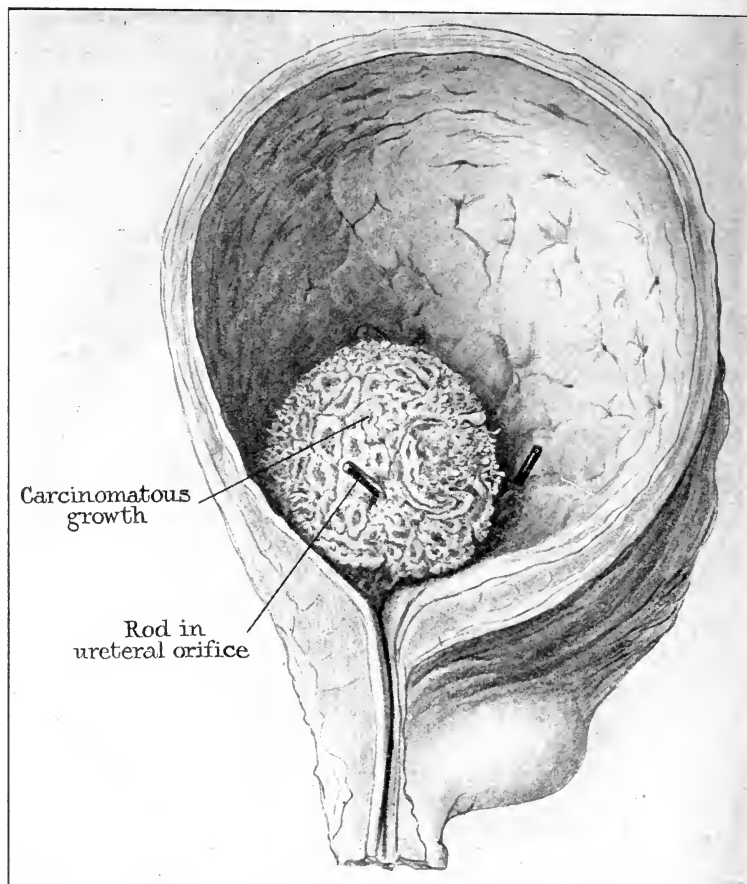
Fig. 254.

It serves to exclude renal causes of the hæmaturia, and to define the nature, size, number, position, and character of the basal attachment of the growths, and also the presence or absence of infiltration of the vesical wall. Pieces of growth may be removed by it for microscopic examination.

Hence the knowledge gained through the cystoscope may indicate the exact nature and degree of surgical interference that may be required, so that the surgeon can adopt the most suitable method without waste of time during the actual operation.

There are certain precautions to be carefully observed in using the cystoscope, and there are limitations to its use and value.

It is not enough for the surgeon to be able to see abnormal conditions in the bladder, but he must be acquainted with the many varieties of normal bladders, and also able to interpret what he sees. For this considerable practice is required, and a sound knowledge of the pathology of the bladder.

It is imperative to conduct the examination aseptically, and with all gentleness, so that neither cystitis nor hæmorrhage follow.

In certain cases hæmorrhage may be so profuse in spite of all gentleness, injections of adrenalin, nitrate of silver, &c., that the cystoscope may fail to give any information of value.

It is wise to wait for an interval in these cases, the patient being kept at rest in bed, and when the urine has become clear, the bladder may be examined through this medium to avoid the risk of setting up fresh hæmorrhage by irrigation (*see* Fig. 254).

To check the bleeding three or four ounces of a $\frac{1}{10000}$ solution of adrenalin chloride may be introduced and left in the bladder for a few minutes. In other cases a weak solution of silver nitrate (grs. ii to the ounce) may succeed after adrenalin has failed. An irrigating cystoscope may be of great value when oozing persists in spite of all endeavours to check it ; quick work with an ordinary cystoscope will succeed unless the bleeding is profuse.

Hæmorrhage is likely to be troublesome with friable growths which surround or grow near the vesical orifice of the urethra ; bleeding from over-distension and rough handling is avoidable.

A very large growth may not allow proper illumination, the beak of the instrument being more or less surrounded by villous processes, or prevented from entering the main vesical cavity.

(8) *Exclusion of other Conditions*—Bacilluria tuberculous and other forms of cystitis, also hæmorrhage from the prostate or kidney. In none of these cases, save in the last, is there the spontaneous character which often marks the bleeding of bladder growths. In renal hæmaturia due to growth the bleeding may be spontaneous, and unaccompanied by other evidence. Here the renal regions should be thoroughly examined at regular intervals, but the cystoscope may show blood issuing from one ureter. In tubercular disease of the bladder the bleeding is never as severe as in growth, and for a long time occurs only at the end of micturition. Other evidence will also be present, and so, too, with the hæmorrhage of enlarged prostate, which will very likely be associated with some residual urine.

Indications for Operation. Growths of the bladder being nearly always fatal, sooner or later, whether from hæmorrhage, or pain, or the results of obstruction, or from these combined, the surgeon should urge an early cystoscopic examination to clear up the diagnosis, and to decide the question of removal. If the cystoscope fail, which it very rarely does, digital and visual exploration should be advised. Suprapubic cystotomy should be performed in the male, and urethral dilatation in the female. While it remains as yet uncertain how many of the cases published as cures are really and permanently so, even in the case of the villous growth, it is an undoubted fact that an early operation cures many patients. In other cases, hæmorrhage, pain, and frequency of micturition may all be very largely relieved.

If in doubt as to recommending cystoscopic examination, the practitioner should remember—(1) that the long intervals between the

bleedings teach strongly that growths of the bladder often pass through a long first stage, during which the growth is connected with the mucous membrane only ; (2) that, following on the above, infiltration of the deeper coats, and dissemination, is often here long delayed. While the long intervals between the bleedings, and the comparative slightness of the other symptoms, may make the surgeon unwilling to urge operative interference, it is right that it should be very clearly put before the patient that it is in this stage only that any hope of a radical cure can be given, and that later on, when the stage of infiltration is reached, not only is radical cure almost out of the question, but the risk of attempting it is vastly increased. The points that a careful and skilful cystoscopic

Nodules of growth

Ulcerated growth

Rods in ureters
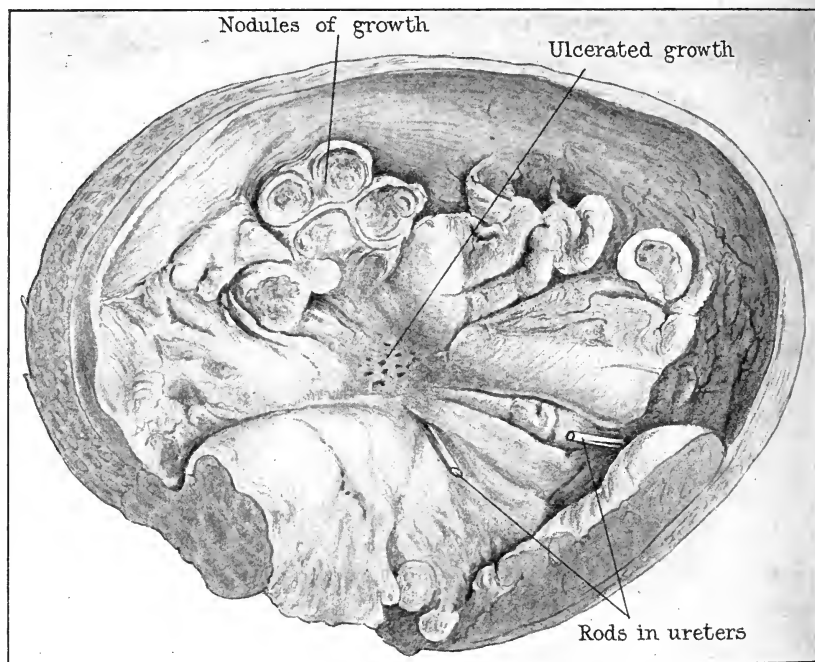
Fig. 255. Flat and infiltrating epithelioma of the bladder. The central part of the extensive growth has ulcerated. (Guy's Hospital Museum.)

examination or a suprapubic exploration will clear up about the growth are the number, site, whether accessible or not, and its relation to the ureter, how far pedunculated or sessile, how far it seems attached to the coats of the bladder. A careful chart indicating all these points should be made at the time. There is a general belief, I think, that pedunculated growths are usually benign. This is a very dangerous belief. Malignant growths or transitional ones becoming malignant form the very great majority of bladder growths. If the growth is at all thick or succulent, if it is at all infiltrating, *i.e.* not a merely implanted pedicle, the odds are greatly in favour of recurrence, however thoroughly the growth is removed. Of 28 cases of pedunculated growths examined by Albarran 15 were malignant.[1] In apparently simple cases recurrence

[1] It is always worth while to remember the vast preponderance of malignant over benign growths of the bladder (Wallace, *Edin. Med. Journ.*, 1893, p. 735). Thus out of

may take place in spite of the most complete operation.[1] The more the
growth approximates to the worst of all types of bladder growth—viz.
the low-lying, broad-based, fixed, sessile lump, especially if with a sloughy
surface encrusted with phosphatic debris, the more hopeless is operative
interference (*see* Fig. 255). If the renal function is seriously impaired,
or if there is any sign of metastases or very extensive local infiltration
palpable from the rectum or vagina, no operation should be undertaken,
except for drainage as a palliative measure in some cases of obstruction of
the urethra.

OPERATIVE TREATMENT

Operations for growth of the bladder may be either radical or palliative,
and the exact nature of the operation, if any, is decided after a careful
cystoscopic examination. Palliative operations are performed for irre-
movable growths. The urine is drained away above the pubis or by
bringing the ureters to the skin.

Radical operations may be undertaken by :

(1) Suprapubic cystotomy.
(2) Transperitoneal cystotomy.
(3) Through the urethra.

Perineal cystotomy does not give a proper access and has been
abandoned.

(1) SUPRAPUBIC CYSTOTOMY FOR REMOVAL OF GROWTH

This is the best method to adopt for the large majority of cases.
Suprapubic cystotomy gives plenty of room with good and safe drainage
after the operation. The risk of cellulitis has been greatly exaggerated,
and can be abolished by drainage of the prevesical space. For some high
malignant growths it is necessary to continue the wound into the peri-
toneum, and to remove the whole thickness of the vesical wall including
its peritoneal coat, but even then the peritoneum can be completely
closed and extra peritoneal suprapubic drainage safely adopted.

But about 85 per cent. of vesical growths are at the base and can be
widely resected, and if necessary the ureters can be transplanted without
opening the peritoneum. This is surely an advantage, for the urine
is often infective. Free drainage is generally required on this account
and because of the difficulty of completely arresting hæmorrhage. The
urethral drainage adopted with the transperitoneal cystotomy is not
always adequate after the removal of growths of the bladder. When free
exposure is required, there is no great advantage in opening the peri-
toneum, for it does not give appreciably more room. It is not the
peritoneum but the recti abdominis which offer the greatest hindrance
to the due exposure of vesical tumours. The peritoneum can be
separated and pushed up out of the way unless the growth invades the
wall of the upper part of the bladder. It acts as a good retainer and
protector of the small intestines, and is, in fact, of value in assisting the
Trendelenberg position. The recti can be relaxed by good anæsthesia
and drawn aside by suitable retractors. The full Trendelenberg position
and a forehead lamp are invaluable aids.

The details of the exploratory incision have been described at p. 602.

88 cases which Albarran personally examined 71 were malignant and 17 simple.   Out of
22 cases Guyon found 19 to be malignant.

[1] *Edin. Med. Journ.*, 1903, p. 735.

It is sometimes necessary to divide some of the inner fibres of one rectus about one inch above the pubis in order to get a proper view of the lower part of the corresponding side of the bladder. The bladder having been opened to the necessary extent, the edges of the opening are secured to the rectus sheath by temporary mattress sutures which pierce all the coats.

Large thin enveloping pads are applied to protect the edges of the parietal and vesical wound and suitable retractors are introduced. Those designed by Thomson Walker [1] are good, for they separate the recti and push out the lateral vesical walls at the same time. The liquid contents of the bladder are gently mopped up with gauze and a gauze roll is inserted above the trigone to push the posterior wall out of the way and to absorb any urine or blood that might interrupt the view.

THE REMOVAL OF PAPILLOMATA

The following excellent account is given by Mr. Thomson Walker. [2]

" The first care of the surgeon will be to enumerate the growths and compare them with his chart. Papillomata vary greatly in their rela-

$\frac{1}{3}$Sc

tion to the vesical mucous membrane. There are papillomata, invariably single, which are attached to the mucous membrane by a long stalk, and there are others set on a short, thick stem, but still distinctly pedunculated. The most frequent type is set upon the mucous membrane like a well-shaped sponge of rather coarse texture, and attached by a base so short that it cannot be called a pedicle, yet too narrow for the arrangement to be termed sessile. There are others
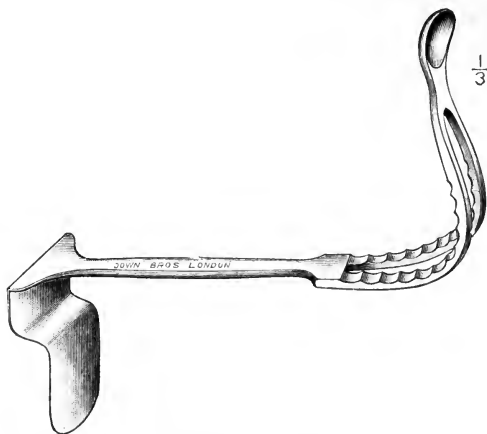
FIG. 256. Thomson Walker's bladder retractor. A self-retaining one with similar blades is also very useful.

which are sessile and which carpet the mucous membrane for considerable areas like a luxuriant low shrub. All varieties, with the exception of the long pedicled type, may co-exist in the same bladder. A very large growth is frequently solitary, and may have a short and comparatively narrow base of attachment, which may, however, extend along the mucous membrane for an inch or more.

" In removing the pedicled variety I usually pick the growth up in long fine forceps, and pass a double strand of very fine catgut through the base of the pedicle, or, better, through the adjacent mucous membrane, which is raised by putting the pedicle on the stretch (*see* Fig. 257). A fine, rounded, curved needle is used for this purpose, and held in a long, fine needle-holder. For transfixing the base at difficult angles I use a small, fine, curved needle, set at right angles to a long fine handle, which is left untempered for two inches close to the needle, so that it may be bent at will to any angle. The thread of catgut is severed and the needle with-

drawn. The two threads are now tied, so that one half of the pedicle is grasped in each, and the pedicle cut through above this. Usually there is no bleeding, but if oozing does occur another stitch may be introduced. The catgut stitches are cut short.

" In larger growths with a short narrow base attached along a line of mucous membrane I commence by placing a catgut stitch through the mucous membrane and muscle above the nearest end of the pedicle. This raises a ridge of mucous membrane, and with scissors this is cut across just short of the pedicle. Another catgut stitch is introduced
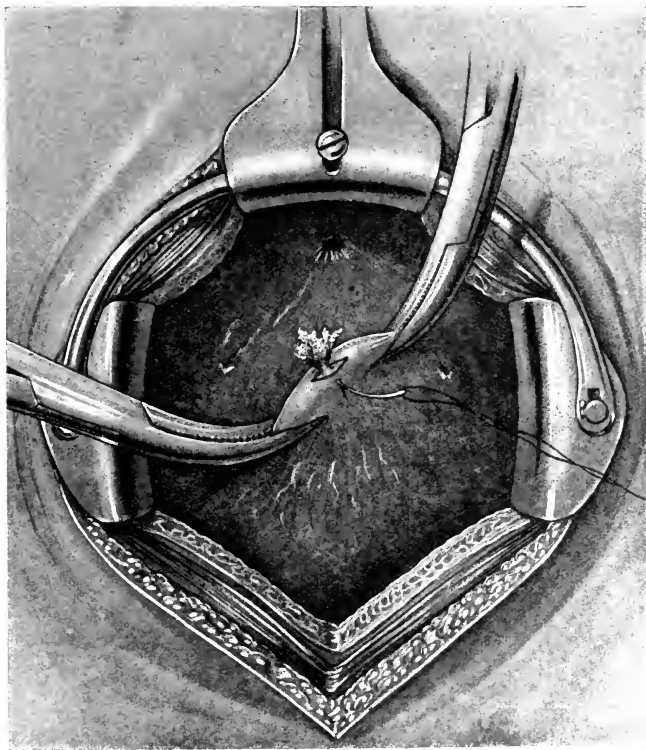
FIG. 257. Excision of vesical papilloma. The mucosa is picked up near the growth, the base of the latter is excised, and the wound is sewn with fine catgut.

by means of the special needle described above. This is tied and a further cut made with the scissors, taking care to clear the last suture and not to cut it away. Should a vessel spout it is picked up in long pressure forceps, which are left on until the papilloma is removed and then taken off, or a catgut ligature may be applied. Bleeding from these vessels is usually controlled by pressure forceps and the pressure of the sutures which close the wound (see Fig. 258). The cutting and stitching are continued until the papilloma is removed. Forcible traction upon the sutures should be avoided, for they will tear out, but gentle traction may be exerted and will bring the wound into closer view.

" Where there is a thick, fibrous pedicle the mucous membrane may be cut round its base, a stitch passed through mucous membrane and

underlying muscle, and the fibrous pedicle cut across, taking a wedge of muscle with it. Having removed the papilloma the stitches are cut short and the wound is inspected. If bleeding is going on at any spot another suture should be introduced and tied and the pressure will control it. A small bud of papilloma should be picked up in fine forceps and snipped off with curved scissors, taking a piece of mucous membrane with it. The cut edges are then brought together with a fine catgut stitch. Where an area of mucous membrane is carpeted with low, shrub-like growth, the strip of the membrane bearing the growths should be excised with curved scissors, and the cut edges united with a series of fine catgut
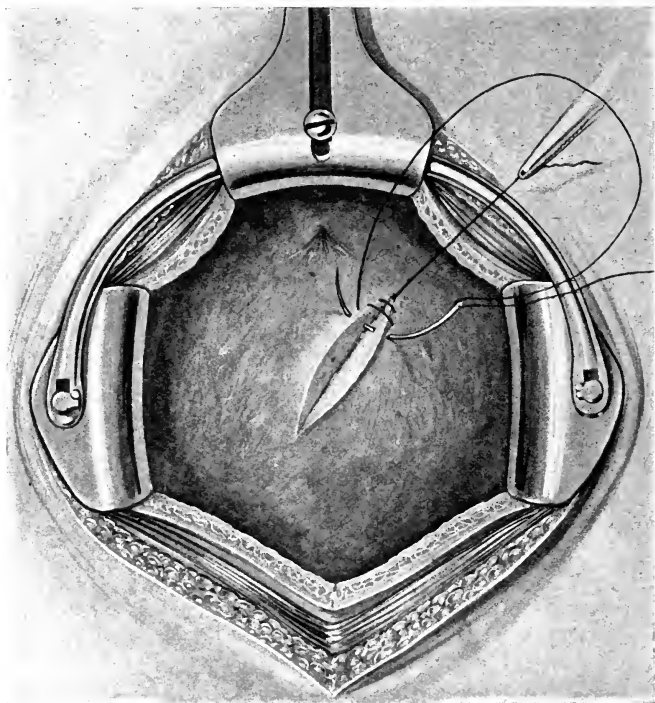
FIG. 258. Excision of vesical papilloma. The wound at the base is closed with a continuous catgut suture.

stitches. In removing the papillomata care should be taken that the edges of the cystotomy wound are not soiled. Before leaving each little wound the bleeding must be completely stopped. Sometimes an oozing from the mucous membrane is difficult to control, and occasionally a few touches with a fine electro-cautery point are necessary.

"It will be noted that the above methods are dependent on good exposure, clean cutting, and accurate suture. In my view rapid healing is more likely to be promoted in this way than by any method of crushing, tearing, or twisting of the base of the growth. The catgut sutures have not caused any inconvenience in my hands. On examination of the bladder with the cystoscope after recovery from such an operation, no trace of the suture is to be found. Silk sutures are to be avoided, as they

almost always accumulate phosphate deposit, and give rise to trouble afterwards.

"A word must be said in regard to clamps. Some years ago I had a clamp made with flat blades, one grooved and the other ridged, about one-eighth of an inch thick, and set at an angle to strong handles. With this I proposed to clamp the base of the growths, and with an instrument like a large adenoid curette to scrape the papillomata from the surface of the clamp. I found there were several objections to this method. It was very difficult to get clamps of the size and angle to suit the varieties and different positions at which papillomata are found in the bladder, so that if the papillomata were to be accurately clamped a number of instruments would be required. Many papillomata are closely related to the ureteric openings, and there is a very real danger of including the ureteric orifice in the clamp, if the clamp is applied, as it should be, so as to include mucous membrane in the bite. I found further that there was a tendency of some part of a large base to slip out of a clamp altogether, and troublesome bleeding followed.

"Where I have to deal with a large solitary papilloma I sometimes use a Guyon's clamp in order to steady the base of the tumour during the stitching. This clamp has a very convenient curve, and on the contact surface of one blade there are several teeth, which sink into corresponding holes on the contact surface of the other blade. This prevents any portion of the pedicle from slipping out of the clamp. The clamp should be carefully adjusted so as to grasp the base of the papilloma with some mucous membrane. When it is in position and locked catgut sutures should be placed on the bladder side of the base, dipping below the convex border of the clamp and out at the other side. These are held aside; the papilloma is clipped away from the concave border of the clamp, which is then removed, and the sutures tied in series introducing an additional one or more if necessary. This method may be used in the large isolated type of papilloma. It is described and recommended by Albarran.[1] It is not suited to the form in which there are numerous small, scattered papillomata, or where a considerable area of bladder wall is covered with clusters of papillomata."

After removal of the growths, the whole vesical mucous membrane is treated with strong silver-nitrate solution (20 to 30 gr. to the ounce), formalin ($\frac{1}{300}$) or other solutions which coagulate albumin with the object of destroying microscopic papillomata which may have escaped observation, and also of killing any fragments which may have been implanted during the operation.

"Having carefully freed the bladder from blood-clot, and removed gauze pads or swabs from the post-trigonal area, the question of closing or draining the bladder will arise. After a trial of suturing the cystotomy wound in these cases, and after one or two failures from serious hæmorrhage, I have abandoned the method. If the bladder is sutured and the urine, by any chance, such as the blocking of the catheter by a clot or the slipping of the tied-in catheter, accumulates and distends it, hæmorrhage is encouraged, and should hæmorrhage take place a retained catheter, however large, is not a sufficient means of drainage. I now drain the bladder in these cases from the first by means of a large rubber tube, three quarters of an inch in diameter. A stitch or two are usually required to close the bladder wound around this tube. In addition I place a small

[1] *Médecine Opératoire des Voies Urinaires*, 1909.

rubber tube, which dips into the prevesical space, at the lower angle of the wound. This ensures the removal of any urine which may escape into this space. The abdominal wound is carefully repaired by uniting the cut portions of recti and approximating the recti muscles by means of catgut sutures.

" In the after-treatment I use a very simple method of removing the urine which is neither a syphon nor a suction method, but merely drains the overflow. One end of a yard of medium-sized soft rubber Paul's colotomy tubing is drawn over the prominent end of the rubber drainage-tube and tied round with a piece of silk to retain it. This is brought through the dressings and passing over the edge of the bed dips into a jar. To ensure that the surfaces do not adhere and block the flow of urine two drachms of olive oil are poured through the tube before adjusting it. The tube is changed at each daily dressing, when the bladder is irrigated with oxycyanide of mercury (1 in 10,000). On the fourth day the drainage-tubes are both removed and the urine may be allowed to soak into large pads of cellulose wadding, or an Irving apparatus may be applied. In my experience the wound heals more quickly without any apparatus."

PARTIAL EXTRAPERITONEAL RESECTION OF THE BLADDER FOR GROWTHS

When it is doubtful whether a growth is innocent or malignant, the following test of Albarran may be useful. The gliding or otherwise of the mucous membrane ought to regulate the depth of the removal of the growth. Whenever the mucous membrane seems fixed to the submucous coat it would be better even in pedunculated growths to resect the entire thickness of the wall, a step still more essential in small sessile tumours. When still in doubt it is better to regard the growth as malignant and to remove it together with a good margin around it, of the entire thickness of the bladder wall. Whenever possible at least an inch of apparently healthy tissue around the growth is removed, care being taken to save the sphincter of the bladder by keeping at least a third of an inch away from the urethral opening. Unfortunately, the large majority of vesical growths occur at or near the trigone. When it is necessary to remove a portion of one ureter the latter may be implanted in the reconstructed bladder ; and in some cases both ureters may be so treated.

The growth can be most readily resected when situated somewhere in the upper or middle zones of the bladder, whereas it may be very difficult or even impossible to excise widely enough when it grows at the trigone without removing one or more ureteral orifices, or trespassing on the sphincter vesical.

The following case illustrates the mode of removal of a common type of malignant growth around one ureter.

An old woman, aged 65, had had hæmaturia almost constantly for three or four months and had wasted a great deal. She had also had frequency of micturition and a great deal of pain in the bladder region, and about the urethra. She looked very ill and sallow. Her tongue was furred. The temperature was normal. She was examined on December 1, 1911, with the cystoscope, under an anæsthetic, and then I saw a growth projecting into the bladder at the site of the right ureter, which could not be identified. Nor could any urine be seen issuing from that

neighbourhood. The growth was shreddy on the surface and was actually bleeding. It did not seem very large, probably about the size of a walnut. It was sessile, but its surface was covered with large papillæ.

Operation on December 4, 1911. The bladder was filled with 12 oz. of water after it had been washed out thoroughly, and then it was opened through an incision extending from just below the navel to the pubes in the middle line, the fibres of the recti being separated. The bladder was identified, the peritoneum being pushed upwards. On incising the bladder the growth could be felt in the neighbourhood of the right ureter, and there were no other growths to be found. All the water was mopped
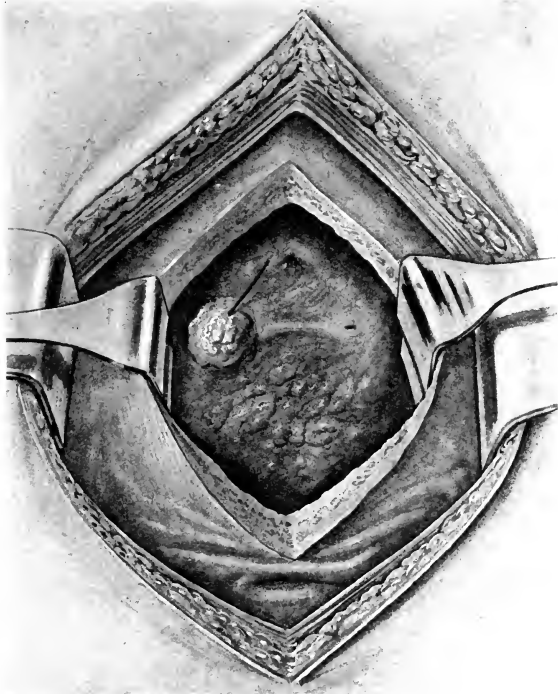
Fig. 259. Carcinoma at left ureteral orifice, with bristle in the ureter.

away and the Trendelenberg position was adopted, and two retractors were inserted to hold the bladder wound open. Then a long tenaculum forceps was applied to the base of the bladder a little above and to the left of the growth, and the base of the bladder was brought up while the growth with about an inch of healthy bladder wall about it was removed with scissors. The incision was carried a little beyond the whole thickness of the bladder wall, and as the growth was brought upwards the right ureter came into sight, greatly distended with clear urine. This was isolated for about an inch and a half, and then a catgut suture was passed through it and the ureter divided just below the suture, which was then used to fix the ureter to the upper angle of the posterior wound in the bladder. The piece of suture within the ureter was drawn out, and divided. Each of the two sutures now left was passed through the corresponding side of the posterior vesical wound and tied. After tying several

large bleeding vessels at the base of the bladder, the posterior wound was carefully sewn with two continuous catgut sutures starting from the lower angle of the wound and extending as far as the ureter, care being taken not to constrict the latter. Then the upper two-thirds of the anterior wound in the bladder was closed until it fitted snugly round a large rubber tube, which was inserted. A wick of gauze was passed into the cave of Retzius. The microscopical examination proved the growth to be carcinomatous. The patient did well at first, but she died six weeks later from ascending nephritis of the left kidney. The right kidney was hydronephrotic and a mere shell.
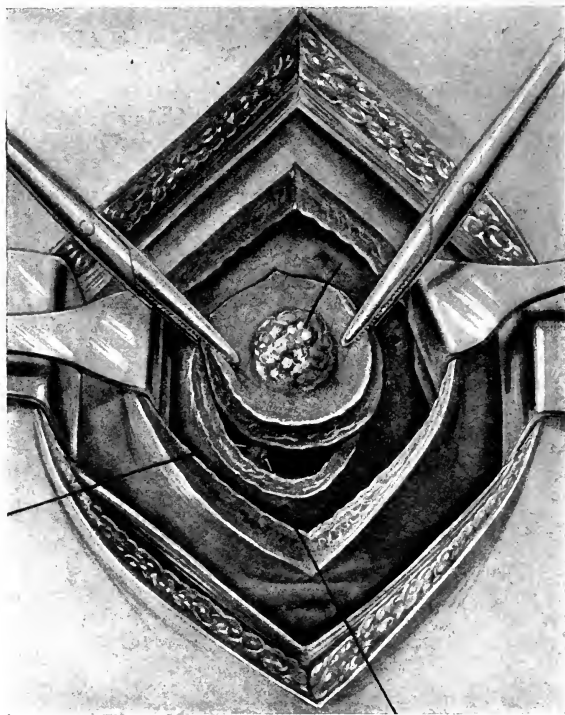
Fig. 260. Excision of carcinoma at left ureteral orifice. The whole thickness of the bladder wall has been isolated around the growth, and the ureter isolated, and transfixed by a catgut suture, which also pierces the bladder wall near the upper end of the incision.

When the ureter is sewn as above to the upper angle of the posterior wound, and care is taken not to constrict it by suture, there is little fear of stenosis of the orifice, less in fact than if the ureter is transplanted by drawing it obliquely through the bladder wall. Moreover, the method recommended is much simpler and speedier. When the space behind the bladder and below the peritoneum needs drainage, a rubber tube is carried from it just below the ureter out through the suprapubic wound. When the tube is withdrawn its track contracts and tends to dilate the ureteral orifice as shown by Thomson Walker.

It is not absolutely necessary to sew the ureter to the angle of the posterior wound in the bladder, for when a good length has required

removal, it has been simply cut across and abandoned in the subperitoneal tissues behind the bladder, with a drainage-tube placed just below it, and passing through the bladder out of the suprapubic wound. Albarran, Walker [1] and Pilcher have adopted this method.

In his case Thomson Walker on cystoscopic examination three months later saw a funnel-shaped ureteral orifice.

Dr. Malcolm Harris, of Chicago,[2] successfully resected the prostate and the greater part of the bladder extra-peritoneally in a man æt. 53 for carcinoma involving the trigone and invading the prostate. The upper end of the bladder was saved, and the ureters were implanted into it.

Fig. 261. Excision of carcinoma at left ureteral orifice. The ureter has been sewn at the upper angle of the incision and a tube inserted just below it to drain the cavity behind the bladder.

The operation was performed on Oct. 5, 1901. A long median suprapubic incision was made, and the peritoneum displaced upwards. The sides and front of the bladder and prostate were cleared down to the base, and the urethra was divided just above the triangular ligament. Beginning from below, the prostate and the bladder were gradually separated from the rectum. "This, which was the most difficult part of the operation, was facilitated by an assistant introducing two fingers into the rectum, thus raising all the parts well forward. The hæmorrhage during this part of the operation, though considerable, was not as severe as was anticipated, and was materially lessened by keeping the bladder well drawn forward, that is toward the suprapubic opening, as fast as it was separated from the rectum. The ureters, as soon as they came into view, were easily divided beyond the disease. The right ureter was considerably enlarged and tortuous, owing to the obstruction which the growth had produced at the ureteral opening. Some small enlarged lymph

[1] *Proc. Roy. Soc. Med.*, January 1910.   [2] *Ann. of Surg.*, 1902, p. 509.

glands which were found in the connective tissue to the side of the bladder were removed. As the vertex of the bladder was not involved in the diseased process, a portion of it, six to seven centimetres in diameter, was retained. The remainder of the bladder and the prostate were removed. Small slits were made in the remnant of the bladder, and the ureteral ends drawn through and stitched with catgut. The small portion of the bladder was then stitched by its edge to the inner edge of the suprapubic opening, except at the lower part. The cavity in the pelvis was packed with gauze, and a large rubber drainage-tube inserted to the bottom of the cul-de-sac. The peritoneal cavity was not opened. Time of operation, about one hour and thirty minutes. There was considerable shock following the operation, but this was slowly recovered from, and in about two weeks the patient was able to sit up. The cavity filled in quite rapidly, and the tube was soon dispensed with. In about a month the patient had gained in strength so as to be up and around. The ureteral openings in the small practically exstrophied bladder were easily seen, and the urine escaping from them was clear, and on analysis normal, with the exception of a small amount of pus from the surrounding parts.

" On drawing the edges of the suprapubic opening together the lower part of the small bladder would dip slightly behind the upper edge of the symphysis pubis. A catheter introduced through the penis reached the small bladder, and nearly all the urine drained off through the catheter. It was, therefore, retained permanently in position." The man was going about and improving, when he developed lobar pneumonia and died early in December 1901.

Dr. Harris was led to retain a portion of the bladder, with a view of its ultimate regeneration into a serviceable receptacle by noticing the remarkable way in which the base and a small part of the posterior wall of the bladder had enlarged in a man who had lost the upper and greater part of his bladder from sloughing as the indirect result of an accident. The man gradually regained the power of retaining his urine quite well.

The upper part of the bladder, however, is never likely to develop the power of retaining much urine, and this fact alone will militate against its enlargement.

(2) TRANSPERITONEAL REMOVAL OF GROWTH OF THE BLADDER

Harrington [1] was the first deliberately to open the bladder through the peritoneum for the treatment of an ulcer at the base. Fifteen years later C. H. Mayo,[2] Scudder and Davis,[3] Judd,[4] Tennant,[5] and Pringle [6] have strongly advocated this method for the removal of bladder growths. They say it gives more room and greater facilities for the removal of growths low down in the bladder, thus allowing more radical operations to be performed. A transperitoneal wound of the bladder, when properly sewn, is not so likely to leak as the ordinary suprapubic extraperitoneal wound on account of the greater adhesive powers of the peritoneum, so that this method ensures a *quicker recovery when drainage of the bladder is not required.* Moreover, the abdominal incision enables the surgeon to explore the abdomen thoroughly, and this may be valuable. Although infection of the lymph glands and dissemination of bladder growths is uncommon and late, yet Judd found an early secondary growth in the liver in one case and infection of the pelvic peritoneum in another. It is also maintained that by this method it is easier to protect and prevent infection of the parietal incision and vesical wall. The prevesical space is difficult to protect with the ordinary suprapubic extraperitoneal operation.

[1] *Ann. of Surg.*, 1893, vol. xviii, p. 408.   [2] *Ib'd.*, July 1908.
[3] *Ib'd.*, December 1908.   [4] *Journ. Amer. Med. Ass.*, December 25, 1909.
[5] *Ann. of Surg.*, 1910, p. 657.   [6] *Lancet*, 1911, vol. i, p. 214.

The following remarks upon this subject by such an authority as Hurry Fenwick [1] are valuable :

"Of course the obvious criticism of the question raised is that no route should be a routine route—no method a routine method—for the removal of vesical growth. Why should we enter the peritoneal cavity, incise a length of valuable posterior muscle layers, and thus necessarily prolong the operation, when we have to deal with a lightly pedicled papilloma which can be readily cut out under the eye, and the whole operation be done within fifteen minutes, with an end result better than if we perform a transperitoneal operation with increased risk ? Should custom, fashion, or authority dragoon a surgeon into effecting such unnecessary mutilation ? But which surgeon would condemn a transperitoneal operation to allow of sufficient access to a deep and difficult growth ? None.

"True surgery is established by the end result ; and the end result is, and should be, our only criterion of what is judicious surgery. No surgery should be routine, for one case differs from another. The decision as to when the transperitoneal route should be adopted must rest upon the combined clinical findings."

I agree with Thomson Walker that the chief difficulty in exposing vesical growths is not the peritoneum which can be displaced well up, but the rigidity of the recti abdominis. Therefore, I take care to make the vertical incision of an adequate length, and relax the muscles by good anæsthesia, flexing the thighs, and if necessary I divide the inner fibres of one or both recti. But I never hesitate to adopt the peritoneal route when the cystoscopic examination indicates the need for removing a part of the bladder covered by peritoneum, nor do I hesitate to open the peritoneum when the need is demonstrated by the ordinary suprapubic exploration.

It is often necessary to do this in order to resect a malignant growth at the upper and back part of the bladder ; more often, I think, than to deal with the majority of innocent or malignant growths at the base.

Operation. The bladder, having been washed out and emptied immediately before the operation, the high Trendelenberg position is adopted and a median incision extending upwards from the pubis for at least six inches is made. The intestines are protected and kept out of the way by large gauze packs. The abdominal wound is also protected with enfolding gauze pads kept in position by suitable retractors. The bladder is then drawn up by two long forceps on either side of the fundus, and a median incision two inches long is made. All urine is gently mopped away and the bladder is examined. If necessary the wound is enlarged. A pedunculated tumour is held up with forceps while its base is transfixed and tied with fine catgut. A sessile tumour is held up with forceps and removed with curved scissors, the resulting wound being either sewn with catgut or cauterised with the thermo-cautery, until all bleeding is arrested ; or the tumour may be separated with the thermo cautery. In any case, some of the healthy mucous membrane must be removed. With a malignant tumour, especially of the infiltrating type, the whole thickness of the bladder wall must be removed, and if possible a margin of at least one inch of healthy tissue must be taken away all round the growth. It is important not to trespass upon the urethral orifice, and no interference with the function of this important part will take place if the wound does

[1] *Med. Annual*, 1911, p. 203.

not reach within one-third to half an inch of it.   In many cases one or both ureteral orifices may be involved in the growth.   When only one is affected an elliptical piece of the bladder around the orifice is isolated, drawn upwards, and the ureter is separated by gauze dissection until a healthy part is reached well above the growth.   At this spot the ureter is transfixed with a catgut suture and divided in front of the suture.   The
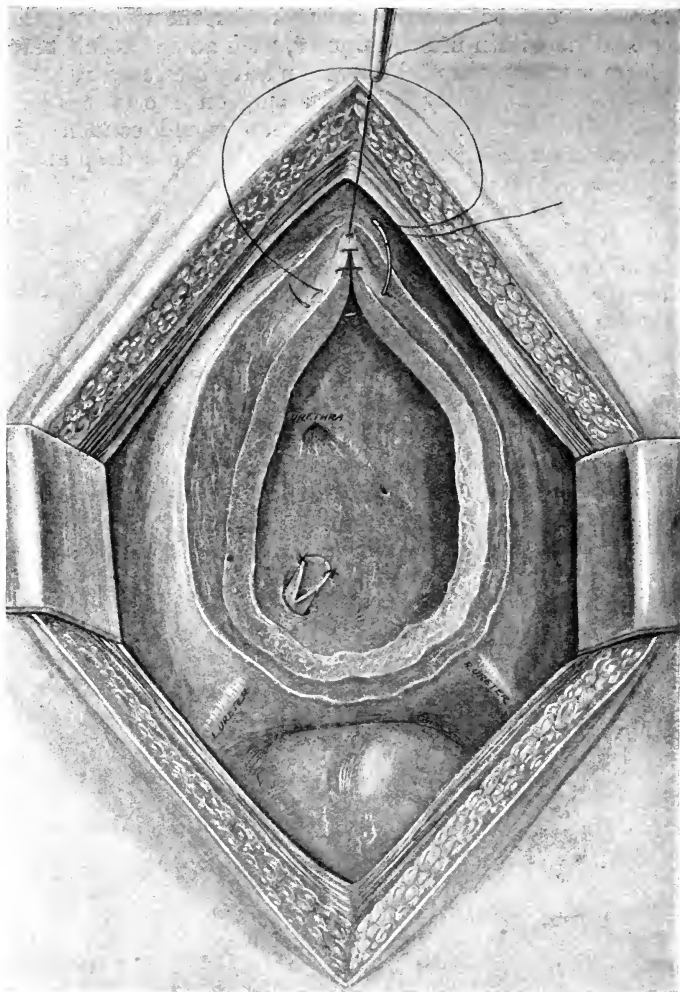
FIG. 262.   Transperitoneal excision of a large piece of the bladder, the left ureter has been implanted in the right half of the bladder.

growth, which is now free, is removed and the ureter is anastomosed to the bladder in one of two ways.   (a) It is sewn to the upper angle of the posterior incision in the bladder as already described at p. 619.   (b) If a large amount of the bladder has had to be removed the ureter is drawn subperitoneally towards the remainder of the bladder, drawn through a puncture in the wall, and secured to the mucous membrane by a couple of catgut sutures.   If the ureter has traversed any of the peritoneal

cavity, the exposed part is covered by sewing folds of the adjacent peritoneum over it. The incision in the posterior wall of the bladder is carefully sewn with catgut and all bleeding is carefully arrested in this way. Then the exploring vesical wound is accurately sewn with a continuous Connell suture of catgut, which as usual pierces all the coats, inverts the edges and arrests hæmorrhage. This is reinforced by a continuous Cushing suture of fine linen thread. If for any reason it is necessary to drain the bladder, a tube is introduced through a separate suprapubic puncture. The tube is inserted before the upper wound in the bladder is closed. As a rule no drainage is adopted either of the peritoneum or of
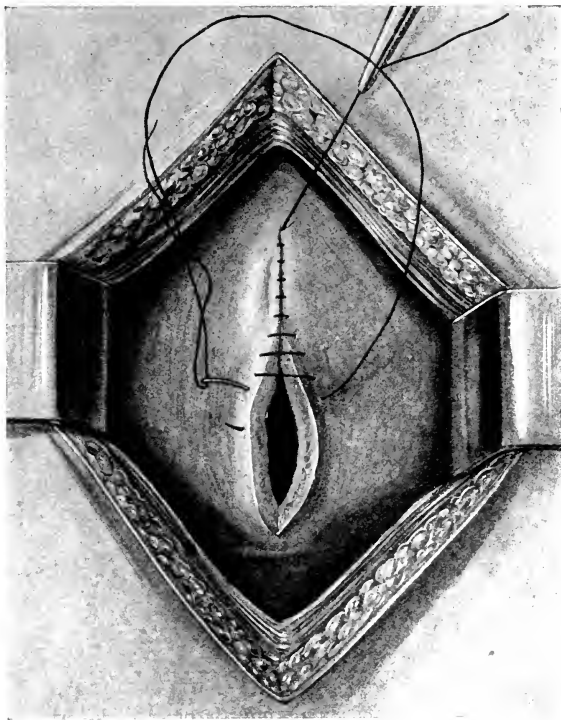
Fig. 263. Transperitoneal excision of growth of the bladder. The wound is closed with a continuous catgut suture which pierces all the coats.

the bladder; and no catheter is used. The patient passes urine fairly frequently at first, and if there be much discomfort or bleeding develop it is well to wash the bladder out several times with boracic solution. In some cases a large rubber catheter is tied in. Judd records fifteen transperitoneal operations for the removal of bladder tumours, at the Mayo Clinic, with only one death, and that was from uræmia in an old man who had severe hydronephrosis on one side. It is probable that free drainage would give such a patient a better chance of avoiding uræmia judging by the great value and absolute need of drainage after prostatectomy in feeble old men.

Six patients were alive and without evidence of recurrence over a year after the operation. One with a malignant papilloma had a similar tumour removed from the opposite side of her bladder eighteen months

later. Sufficient time had not elapsed in most of the others for any valuable conclusion to be made as regards the question of recurrence. It has not yet been demonstrated that the transperitoneal route confers a greater freedom from recurrence than the suprapubic method. This depends much more upon the actual technique and freedom of the removal.

The following case illustrates the value of the transperitoneal route for the resection of a malignant growth at the fundus.

A stout lady age 54 had five attacks of profuse hæmaturia, between May and November 1911. On two occasions the bladder was distended with clots, and once the patient was unable to pass water for twenty-four hours, when a great deal of
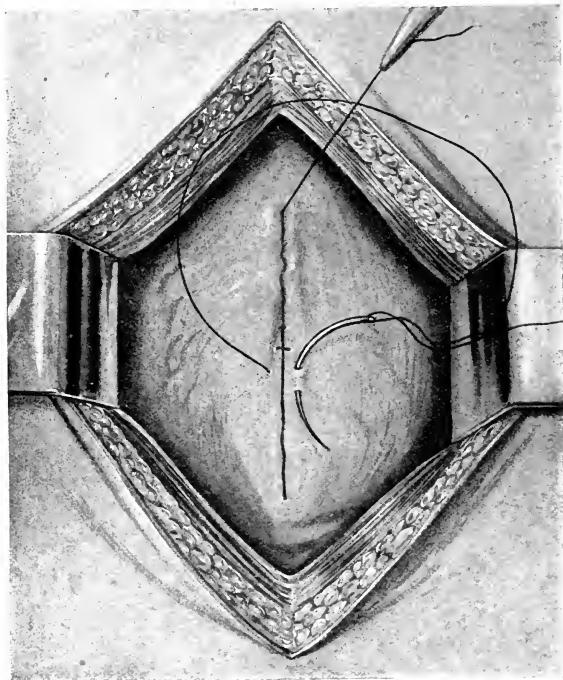
Fig. 264. Transperitoneal excision of growth of the bladder. A Cushing serous suture is used to invaginate the deep suture.

clot came away, followed by blood and urine. She also had a little cystitis in the intervals between the attacks of hæmaturia.

Cystoscopic examination on November 15, 1911, revealed a large malignant growth on the anterior wall of the bladder high up and a little to the right of the middle line. The growth was of the flat ulcerating and infiltrating type, and was bleeding at one spot.

Operation on November 29, 1911. Mr. Dunderdale gave A.C.E. Dr. Lewis Jones was present. The bladder was washed out with boracic lotion and left empty. The patient was placed in the Trendelenberg position and the abdomen opened through an incision extending from the pubes to the umbilicus. Directly the abdomen was opened a growth in the bladder could be felt to the right of the upper portion and extending to the posterior and anterior surfaces. It was a hard disc two inches in diameter, encroaching upon both the peritoneal and to a lesser extent the non-peri-toneal surface of the bladder. A hand was passed to the liver with some difficulty and this was examined and found to be normal. There were no enlarged glands any-where in the abdomen and no sign of peritoneal secondary growth. The intestines were packed away carefully and the bladder was drawn up   After dividing lateral

peritoneal connections of the bladder it was possible to bring the tumour into the wound, the edges of which had been most carefully protected by gauze pads which were secured in position by means of a self-retaining retractor and mattress salmon-gut sutures passing through the entire thickness of the abdominal wall. The bladder was then opened about two inches to the left of the growth, which was gradually removed by cutting round it with scissors. Each bleeding-point in the cut surface of the remainder of the bladder was at once secured with Spencer-Wells forceps, which also served to hold the bladder up. No enlarged glands were found in the iliac region. The cut surface and cavity of the bladder were mopped with nitrate of silver gr. 20 to the ounce.

No secondary growth could be felt or seen in the bladder. The large wound left in the bladder was closed as follows :

A through-and-through catgut suture was inserted at the postero-inferior angle of the wound and the posterior part was closed by a continuous mattress suture of catgut which was tied on the mucosa. Two similar continuous sutures were used until only a hole large enough to hold a large rubber tube with three quarters of an inch diameter was left. This tube, which had two side holes in it, fitted snugly into the bladder and was sewn to the skin on either side. A sero-muscular silk suture was then used to invaginate the suture line in the bladder. Then the packs were removed and the pelvis thoroughly dried. The parietal peritoneum was closed with a continuous silk suture. There was some difficulty in completing the closure of the lower end of the wound, but this was done by picking up some of the serous coat of the bladder on either side. Three wicks of gauze were then used, two above extending to either side of the bladder below the peritoneum, and one passing into the cave of Retzius below the tube. The operation lasted about an hour and a quarter. The patient was very little collapsed at the end and had lost very little blood.

The patient did well for four days and then began to bleed from her wound, and died in spite of all endeavours to control the hæmorrhage, which was a general ooze. The patient was a bleeder and had bled freely six months earlier after I removed gall-stones from her gall-bladder and bile ducts.

In a man aged 45, who had a similar but larger growth at the upper part of the bladder, I explored suprapubically and found it necessary to prolong the incision into the peritoneum in order to remove the growth with an adequate margin. A little more than the upper half of the bladder was removed. The patient did well for over a year, and could retain 15 oz. of urine. Later a grafted growth appeared in the cutaneous scar ; and when the patient appeared the groin glands and the ramus of the pubis were involved, but the bladder remained healthy to the end.

(3) REMOVAL OF VESICAL GROWTHS WITH THE OPERATING CYSTOSCOPE

This method is of very limited application and requires special skill and experience, and is clearly only applicable to innocent growths, mostly small papillomata. It can hardly allow such a radical removal as is possible by the suprapubic method, and surely with the well-known tendency to recurrence and malignancy, a thorough removal is indicated here. Moreover, the irritation of an incomplete removal tends to increase the rate of growth and degree of malignancy of vesical tumours. I venture to quote Mr. Thompson Walker's [1] concise remarks upon the subject.

" Binney [2] discusses at length the present status of *intravesical operations for tumours of the bladder*. The operating cystoscope by which these are performed was introduced by Nitze, and recently instruments have been introduced by Luys and Kiersmaecker. The method has been used by a large number of surgeons, who claim the following advantages for it : (1) Small mortality. Weinrich found one death in 150 cases, whereas von Frisch reported 14 per cent. mortality in 300

[1] *Med. Annual*, 1912, p. 160.
[2] *Boston Med. and Surg. Journ.*, 1911, T. 226.

cases of suprapubic operations; (2) The avoidance of complications such as fistula, sepsis, phlebitis, or pneumonia, involving long convalescence; (3) The ability of the patient to continue work; (4) More thorough inspection permitted, and less danger of overlooking small tumours; (5) The avoidance of danger of implanting tumour cells in other portions of the bladder or in the suprapubic scar; (6) Greater applicability to recurrent tumours.
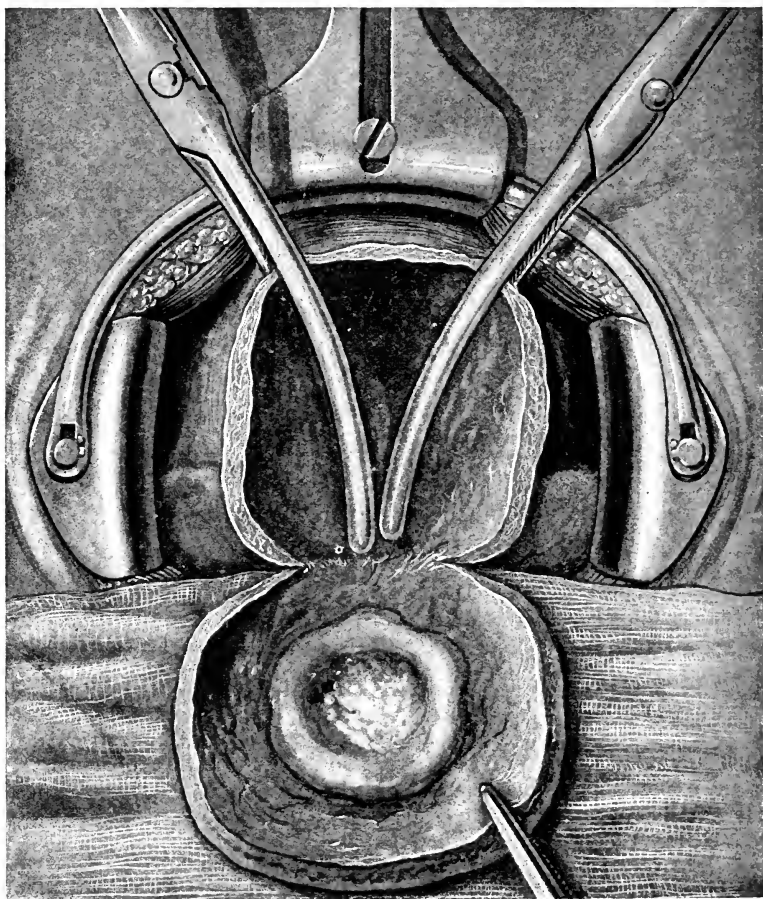
FIG. 265. Excision of flat epithelioma from upper part of bladder. The clamps control the hæmorrhage. The bladder is reconstructed by continuous catgut piercing, and continuous Lembert sutures.

" In answer to these claims of superiority for the intravesical method, the following may be urged : (1) The mortality of suprapubic operations upon the same growths that are subjected to this method is nil in the hands of a competent surgeon ; (2) Such complications as fistula, &c., should not occur; (3) The presence of a papilloma of the bladder is sufficiently serious for the patient to devote time for its thorough removal ; (4) and (5) Pre-operative cystoscopy with charting of papillomata, free exposure and the application of a solution of silver nitrate,

meet these ; (6) Recurrent growths are malignant, or about to become malignant, and should be treated as such."

Büerger [1] has improved the operating cystoscope, to allow the introduction of forceps and snares of adequate size. And he strongly advocates the use of these instruments for the removal of papillomata and callous ulcers ; and also for exploratory excision in suspected carcinoma of the bladder or prostate. He records the following case of papilloma excised with the snare.

CASE 5. H. L., 56 years of age, was referred to me by Dr. K. Schlivek Dec. 10, 1912, because of persistent hæmaturia. The bleeding dated back nine months, although it was most severe during the past two months. Cystoscopic examination revealed two papillomata, a small one a little less than a centimetre in diameter, behind the right ureteral orifice, a larger tumour, about two and a half centimetres in diameter, behind the left ureteral orifice. The general appearance of these tumours, their dendritic nature, and the likelihood of the presence of a pedicle determined me in attempting their removal with the endovesical snare. On Dec. 12, therefore, the operating cystoscope was introduced and both tumours removed with the endovesical snare. The left and larger tumour was removed in two pieces ; the right one detached as a whole. Rather copious bleeding followed, although it ceased spontaneously after irrigation. As a final step, the bases of the tumours were fulgurated with the Oudin current.

The rapidity and effectiveness of this simple procedure, in this case, has led Dr. Büerger to adopt it as a routine measure, and he mentions seven subsequent cases " successfully treated in this way."

While congratulating Dr. Büerger on his invention and operative skill, I am sure he will be the first to admit that too little time has elapsed to prove *permanent* success in these cases. With his cutting-forceps Dr. Büerger removes a piece of mucous membrane or a suspicious growth, for microscopic examination.

The Removal of Vesical Growths in Women. Suprapubic cystotomy is not necessary for the removal of pedunculated benign growths from the female bladder, for these can be removed through the dilated urethra with less risk, and with little, if any, more chance of recurrence. Malignant and sessile growths must be removed suprapubically, as in the male. When the surgeon has decided to remove a growth through the urethra, the bladder is washed out, and the urethra is dilated with Kelly's conical dilators. A large Kelly's speculum is then introduced, and the growth is sought and brought into view, and removed as described above (p. 615).

When partial resection is necessary for growths at the trigone, the vaginal route is occasionally applicable. A longitudinal incision is made in the anterior-vaginal wall, and the growth resected ; the bladder is reconstructed, and the vagina carefully sutured. The bladder is drained with a self-retaining rubber catheter. I think the suprapubic route better because it gives more room and the risk of fistula is far less.

RESULTS OF REMOVAL OF BLADDER GROWTHS

Dr. F. S. Watson in a valuable paper in the *Ann. of Surg.*, 1905 (vol. xlii, p. 805), gives the results of his careful analysis of the records of 653 operations for various growths of the bladder. This number includes the cases published by Albarran in 1892, and others collected or observed by Watson since that time ; 243 of the operations were for benign and 410 for malignant growths. From this study Watson concludes that " the sum and substance of the result of operative interference

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[1] *Medical Record*, June 21, 1913, and *New York Med. Journ.*, April 26, 1913.

up to the present time may be stated thus : If the operative deaths and rapid recurrences are combined under the one heading of operative failures, such failures are seen to have occurred in the 28·6 per cent. of the benign tumours, exclusive of myxoma, and in 40 per cent. of the cases of carcinoma."

Watson's collected cases included 17 partial resections for papilloma, with 1 death, 4 for myoma, with 1 death, making a total of 21 partial resections for innocent growths, with 2 deaths, a mortality of 9·5 per cent.

For carcinoma there were 91 of these operations, with 17 deaths—a mortality of 18·6 per cent. It is interesting that this death-rate was less than that for the 222 suprapubic operations without resections, for the latter were attended by a mortality of 28 per cent.

There was a freedom from recurrence for over a year in 37·5 of the cases of papilloma, as compared with an immunity for over a year in only 27·5 per cent. after suprapubic operations without resection. It is hardly necessary to mention that recurrence often takes place after a year.[1]

" The very large percentage of recurrence seems to point logically to the necessity of more radical measures in benign as well as in cases of malignant tumours, if we are to hope for better results."

Dr. Watson even goes so far as to suggest " that total extirpation of the bladder and of the prostate, if it be involved in the pathological process, be done at the outset in all cases of carcinoma that have not extended beyond the limits of the above-named structures, and in which it is believed that there are no metastases, and that the same measures shall be applied in all cases of benign growths in which recurrence has taken place after a primary operation for their removal." While fully conscious of the need of adopting more radical measures in all cases, especially of the wisdom of partial resection and even complete resection in suitable cases by very skilful and experienced surgeons, I cannot endorse Dr. Watson's recommendations in their entirety for the following reasons :

(1) The immediate mortality of total extirpation has been as high as 56 per cent. in the 25 cases collected by Watson, as compared with 18·6 per cent. in 91 partial resections ; but it is likely that the death-rate of both operations will be very considerably diminished in the hands of skilful surgeons, from improvements of technique and a better selection which increasing experience may enable them to make.

(2) The primary difficulties and dangers of transplanting the ureters into the bowel and the unsatisfactory character of the ultimate results as regards want of proper control of the urine, and the liability to ascending infection and ureteral obstruction. Dr. Watson proposed to get over these difficulties and dangers by performing bilateral nephrostomy with ligation of the ureters some four or six weeks before the radical operation. This provides freer drainage than any transplanting operation, and Watson believes that the immediate risk even of the bilateral operation would be much less than that of ureteral implantation. He also states that the annoyances and dangers of bilateral renal fistulæ are small, and avoidable to a large extent. Preliminary bilateral ureterostomy as recommended by Fenwick is better, and the resulting fistulæ are more manageable.

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[1] In the practice of brilliant individual surgeons the results are much better. Thus Fenwick has a mortality of 2 per cent. from villous papilloma and only 7 per cent. for carcinoma, and recurrence in only 16 per cent. of villous papillomata.

CHAPTER XXXIV

CYSTECTOMY

This operation has been performed by Bardenheuer and Gussenbauer. The first successful case was by Pawlik, of Prague. Clado has had a second. Both of these were in women. In each case the operation was done in two stages, the ureters being first diverted to and secured in the vagina, and then, about three weeks later, the bladder removed. The vagina by the second operation was converted into a pseudo-bladder, the urine being voided through the urethra. Pawlik's patient was well sixteen years after the operation. Drs. Tuffier and Dujarier [1] described a successful case of complete extirpation of the bladder in a man in one operation, the ends of the ureters being implanted into the rectum. Two months after the operation the man was able to do his work.

Indications. The entire removal of the bladder is an operation which must not be lightly undertaken, for it leaves the patient with permanent urinary fistulæ, which are very troublesome. It is true that with transplantation of the ureters into the bowel the sphincter ani provides a fair control of the urine, but the dangers of ascending nephritis are so great that most authorities have advised against this method. Moreover extirpation of the bladder is a difficult operation, which carries a high mortality.

(i) Malignant growth is the commonest indication especially when the growth is so extensive or unfortunately placed that its free removal destroys all hope of a continent bladder. When a malignant growth infiltrates the bladder wall at or near the sphincter vesicæ, there is little hope of eradication of the disease without cystectomy. Soft rapidly growing carcinoma, especially if recurrent and extensive, calls for cystectomy, but this operation is contra-indicated in late cases when the bladder has become adherent to neighbouring structures, or when lymphatic infection or dissemination has taken place. Fortunately the disease is confined to the bladder for a long time in the majority of cases, and kills by obstruction of the ureters with ascending nephritis, and exhaustion from pain, hæmorrhage, sleeplessness and chronic uræmia. To be successful the operation must be undertaken before the patient's health is undermined.

(ii) The operation has been performed for severe and late tuberculous ulceration with contraction of the bladder, frequent micturition and sleeplessness, but it is not to be recommended for this condition.

(iii) Some cases of ectopia vesicæ.

Cystectomy carries such obvious disabilities that it is rarely advised or accepted early enough to enable us to judge of its real value. When undertaken earlier its mortality ought to be greatly reduced, and the prospect of freedom from recurrence greatly increased, but the trouble-

[1] *Revue de Chirurgie*, April 1898.

some urinary fistulæ remain. With suitable apparatus these disabilities can be diminished, but not entirely abolished. The operation certainly relieves the patient from much suffering and at the same time offers a fair chance of cure of the malignant disease.

Preliminary Ureterostomy. To divert the urine and improve the condition and function of the kidneys and thus make cystectomy safer, easier and speedier, Watson strongly advocated preliminary nephrostomy. Rosving suggested and Fenwick adopted [1] ureterostomy with the same object in view. Fenwick now finds it better to bring the ureters out in front, for the dressing and care of the fistulæ is easier than when the lumbar route is adopted. He also ties the upper vesical arteries at the same time. Rosving has brought the ureters out through the triangle of Petit.

The ureters have been diverted into the rectum, vagina or urethra, but the general opinion is in favour of bringing them to the skin, except in some cases in women, where the vagina is suitable and very convenient for the preliminary ureterostomy as in Pawlik's case. Transplanting them into the rectum is almost certain to be followed sooner or later by ascending suppurative nephritis, and in the majority of cases the transplantation has not been completely successful, some or all the urine escaping through cutaneous fistulæ.

Wherever the ureters are diverted there is a great liability to stricture of the orifices with interference with the renal function and ascending nephritis, so that great care must be taken to make and maintain satisfactory openings.

Operation. As a rule this should be performed at least a fortnight after preliminary biureterostomy. When the growth has not invaded the peritoneal coat of the bladder, it may be possible to perform cystectomy extraperitoneally, but when the operation is indicated at all it is better to open the peritoneum so that the liver, lymph glands, pelvic peritoneum and the extent of the growth can be examined before finally deciding upon the operation. The recorded cases show the wisdom of this step, for in four of the immediate fatalities secondary growths were discovered after death, and it is probable that some of the many deaths within a year of the operation were due to secondary growths not discovered at the operation. Moreover, this step makes the operation easier and speedier. With careful packing, and the Trendelenberg position, the risk of peritonitis is small, and when the bladder is not opened during the operation it is almost nil. When cystectomy is indicated the growth is usually infiltrating and basal, therefore its extirpation demands the removal of the prostate, and this makes the operation somewhat easier and the risk of hæmorrhage less, for it leaves only the urethra to be tied.

The question of opening the bladder during the operation is an important one. Even with preliminary ureterostomy and irrigation of the bladder, the contents of the latter are more or less septic, so that it is desirable to remove the bladder entire, and unopened. This is the ideal which is attainable with careful and reliable cystoscopic examination, but when there remain doubts as to the need of cystectomy, the bladder must be explored and carefully examined before embarking on such a serious operation as cystectomy. For the same reason preliminary ureterostomy must not be performed without certain knowledge that the bladder cannot be reconstructed after the growth has been well removed.

[1] *Brit. Med. Journ.*, June 1904.

The Suprapubic Operation. A very free vertical incision is made and some of the fibres of the recti are cut across.

The bladder may be separated either (A) *from above downwards* (Lund), or (B) *from below upwards* (Harris).

A. (1) *Lund's Method.*[1] Mr. Lund moved the whole bladder for extensive papillomatous growth, but the patient died three days after the operation of pre-existing renal suppuration. The following excellent description of the operation is taken from the *Lancet :*

The patient was placed " in the dorsal, and not in Trendelenberg's position. The bladder was washed out and then moderately distended with boric lotion. A vertical incision was made in the middle line about four inches long, and the recti muscles were separated but not divided either transversely or at their attachments into the pubes. Great care was taken not to open the peritoneal cavity. The bladder was then easily exposed and opened, and a digital examination was made. The growth was chiefly confined to the trigone and lower half of the bladder, the fundus being fairly free ; some of the papillomata were long and branching. To the right of the fundus was a pouch. Mr. Lund at once determined to remove the whole bladder. Commencing at the fundus, the peritoneum was stripped off, and in doing this two small rents occurred, neither of them half an inch in length, and they were at once repaired with a continuous catgut suture. The stripping was tedious, but not difficult. Then working at each side alternately and clamping and ligaturing numerous fibrous attachments, the left ureter was exposed and divided close to the bladder, the cut renal end being for the time held in catch forceps. The bladder being now fairly free, it was easier to locate the right ureter, and after this was accomplished and dealt with the viscus was rapidly turned forwards and downwards until the upper border of the prostate came into view. Gentle dissection with the finger separated the rectum, and all that now remained was the neck of the bladder. After freeing it as close up as possible to the triangular ligament a stout silk ligature was passed round it, and the neck was divided. The hæmorrhage was never great, any vessel seen being divided between double ligatures.

" The ureters were next dealt with. Through each cut end a fine catgut ligature was passed and looped to facilitate subsequent drawing down into the rectum. A finger being passed per anum, sinus forceps were guided along it as far up the bowel as possible, probably about four inches, and were then made to perforate the bowel. In this way, by drawing upon the catgut ligatures, the ureters were pulled downwards through the perforation, and as far as could be judged about one inch of each ureter lay free in the rectum. No attempt was made to fix the ureters by suture to the rectum, but the transfixing ligatures, being brought out per anum, were tied round a large piece of rubber tubing. The operation had occupied two hours, and, in spite of skilful administration of chloroform and ether, the patient was much collapsed. A Keith's tube was placed in the lower angle of the suprapubic wound, and the cavity was lightly packed with iodoform gauze. No tube was used for draining the rectum. Mr. Lund thought that the urine would easily find its way out along the ligatures attached to the ureters, but in this he was mistaken."

Urine accumulated in the rectum and leaked through the supra-

[1] *Lancet,* 1902, vol. ii, p. 1624.

pubic wound until a rectal tube was introduced on the second day. The patient died from suppurative nephritis and uræmia.

A. (2) *Fenwick's Method.* With a preliminary bi-ureterostomy Fenwick feels certain he can now remove the bladder without excessive risk if the general condition of the patient is good. The following is his method :

"The technique of excision of the bladder is simple *if the viscus is not adherent.* Its secret consists in the operator using a strong electric head lamp, appropriate retractors, and in shelling out the *distended* bladder without opening it except at the vesical orifice, by keeping strictly to the outer muscular layer of the organ. A vertical skin and a transverse muscle incision are made suprapubically. The bladder being brought into view, the posterior aspect is first separated by scissor-clipping from the peritoneal layer as far down as the posterior border of the prostate. The separation proceeds *between the prostate and the bladder* base until the trigone is reached. If there is any suspicion of cancer, the vesicles and prostate must be removed also, and in this case the shielding hand protects them from the rectum, while the scissoring continues. The anterior surface is now separated from the pubes as low as the prostate.[1] With a little tactile dexterity the scissors (a broad-bladed pair) can be made to cut cleanly through the vesical orifice—if the prostate may be left—and the trigone. The freed bladder is now lifted on to one side to allow of the ureters being traced ; these are detached a little way up and divided. If the prostate has to be ablated, the scissors aims lower and cuts through the membranous urethra to join the posterior incision.

"If the posterior upper wall is invaded and the peritoneum involved, this must be taken freely away, and flaps of peritoneum brought up from adjacent areas.

"Excision of the bladder for cancer is not one that a novice in surgery had better undertake. It often entails much patience and great skill to avoid tearing open vessels and bowel. Moreover, a false diagnosis of cancer of the bladder and excision on a false premise would bring unthinkable discredit on surgery and untold misery to the patient."

B. The following is a modification of Dr. Harris's method of partial extirpation, in which he was able to leave the upper part of the bladder, where it was covered with peritoneum.

The bladder having been washed out as usual and distended with air, a long vertical or transverse incision is made above the pubes, exposing the bladder extra-peritoneally. The bladder is opened, and the exact extent of the disease determined, especially as regards the freedom or otherwise of the prostate. The interior is then cleansed, and a pack of gauze left within it for collecting the urine, which is usually septic, as it issues from the ureters, unless a preliminary ureterostomy has been performed.

The surgeon then separates the bladder from the pelvic wall by blunt dissection as far as the prostate, or if the latter is involved as far as the triangular ligament. This procedure is easily carried out on the anterior and lateral aspects, but difficulty will be experienced in separating the bladder and prostate from the rectum ; and an assistant should pass two fingers into the rectum as guides. If the prostate is to be removed the urethra should be first divided just above the triangular ligament,

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[1] At this stage the bladder should be emptied with a catheter.

as recommended by Dr. Harris. The separation of the prostate and bladder from the rectum can then be carried out far more easily by working from below upwards and backwards, the bladder being meanwhile pulled forwards and upwards as far as possible to provide a better view and to control hæmorrhage. The ureters are sought, clamped, and divided above or beyond the disease. The peritoneum is now opened above the bladder, the Trendelenberg posture adopted, and the field of operation carefully isolated by gauze packing. The peritoneal covering of the bladder is incised and separated from the bladder, but if any of it is involved or adherent, it should be excised with the bladder. The remaining flaps of peritoneum may be sewn together if possible after carefully drying the pelvis, in which a drain may be left. The ureters are then implanted into the vagina, rectum, or urethra. A drain is passed into the extra-peritoneal space from which the bladder has been removed. The upper part of the parietal wound is then closed.

Cystectomy by the Combined Suprapubic and Perineal Method (Küster). There is rarely any need for the perineal wound which adds to the length of the operation without conferring any material advantage.

First, the prostate and bladder base are separated from the rectum through a perineal incision, and then the suprapubic separation of the bladder is carried out. For the same reason symphysiotomy is not to be recommended, for although it gives good access the time consumed in wiring is a great disadvantage. Moreover, the wound is liable to infection, so that the wire may need removal afterwards.

Results of Cystectomy. The *mortality* of cystectomy has been high, partly on account of the magnitude of the operation, but chiefly due to its adoption as a forlorn hope in very late cases where the growth is very extensive or infection of the lymphatic glands or even dissemination has occurred. And the condition of the kidneys as a result of long-continued backward pressure and ascending infection has been very bad in a number of cases.

Dr. Watson[1] has collected the records of 25 cases of total extirpation of the bladder for carcinoma, with 14 deaths, a mortality of 56 per cent.; out of the 11 that recovered, 6, or 54·5 per cent., were known to be free of recurrence a year later.

Later, Thomson Walker[2] found the immediate mortality in the 39 recorded cases to be 46·1 per cent.

Rosving[3] reported three cases before the German Association of Surgeons—one, a man aged 67, died eight days after the operation; one, a man aged 30, was alive and well eleven months after the operation; and the third, a man of 57, had survived the operation a month at the time of the report. Fenwick has recorded three successful cases.

The *ultimate results* have been poorer still, for recurrence has been early in many cases, and in the others either obstruction of the ureters or ascending nephritis has ensued.

Only two cases have survived for over five years.

More careful selection of suitable cases, both before and after abdominal exploration, earlier operation, and improvements in technique, will lower the mortality and improve the ultimate results; but the satisfactory drainage of the urine is a difficult problem.

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[1] *Ann. of Surg.*, vol. xliii, p. 805.
[2] Burghard's *System of Operative Surg.*, vol. iii, p. 473.
[3] *Zeit. F. Chir.*, vol. xxi, 1907, p. 94.

OPERATIONS FOR STONE IN THE BLADDER

CHOICE OF OPERATION. LITHOLAPAXY OR LITHOTOMY

It is hoped that the following points, while they do not exhaust the subject, may be found of practical use.

(1) **The most desirable operation.** Granted that the surgeon is equally skilful in litholapaxy and lithotomy, the former in suitable cases is the more desirable operation from the patient's point of view, for (a) the risk to life is less (except in *male* children, when lateral lithotomy is a little safer). The mortality of litholapaxy by Freyer [1] in 815 adult males was 3·06 per cent., in 192 male children 1·04 per cent. There was no death in 28 females. The mortality of 55 perineal lithotomies in adult males was 18·20 per cent. and in 200 male children only ·5 per cent. The death-rate in 149 suprapubic lithotomies in adult males was 12·75. (b) The amount of pain and inconvenience is much less, and (c) the recovery is much more rapid.

(2) **Amount of experience of the surgeon.** Every attempt should be made to become familiar with the use of the instruments, both outside the body and also by passing a lithotrite for examination of a calculus whenever one is felt on sounding. No surgeon who has not seized abundant opportunities of practising the needful manipulations will do wisely in attempting to crush a hard stone which weighs an ounce.

(3) **Size, kind, and number of stones.** As to size, up to 1 oz. or $1\frac{1}{2}$ oz., it is probable that, with the majority of stones, in fairly practised hands, lithotrity is immensely superior to lithotomy as far as immediate mortality is concerned. I use the term "immediate" advisedly, because of the more frequent recurrence, with its results, after lithotrity, and would refer my readers to the remarks on this point at p. 639. Much larger stones may be successfully crushed by an experienced operator with the specially strong instruments now made. Freyer [2] gives a list containing 31 cases in which the stone averaged 2 oz. 5 drs. in weight, all of which were successfully crushed. The largest stone which Freyer has crushed weighed $6\frac{1}{8}$ oz., the operation lasting two hours. The same author, moreover, considers that in all cases trial should be made of litholapaxy before a cutting operation is performed.

Mr. H. Milton [3] records an epoch-marking case in which he crushed a stone (urates and phosphates) weighing over 12 oz. The operation lasted two hours, and an especial lithotrite with a gape of five inches was used. Such an operation is, of course, only possible for an expert with especial experience, such as Mr. Milton's in Egypt. This surgeon

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[1] Freyer, *System of Op. Surg.*, Burghard, vol. iii, p. 518.
[2] *Lancet*, December 12, 1896.
[3] "Lithotrity, Simple and Complicated," *Lancet*, April and May 1896.

had before [1] referred to the extraordinary tolerance which Orientals show to all operations connected with the genito-urinary apparatus.

The difficulty of a decision sometimes met with here is well expressed by the words of Sir W. Fergusson, that the greater is the experience of the surgeon the greater will sometimes be his doubt.

To any one with very limited experience rashly contemplating an attack upon a hard stone I would recall Mr. Milton's words : [2] " During the first twenty minutes of a long crushing most men can maintain the necessary delicacy of manipulation, combined with the exercise of considerable force ; but when it comes to working at the same strain for a second, third or fourth, or even fifth, sixth or seventh period condition begins to tell . . . this force has to be exerted with the greatest discrimination and the greatest patience." In addition to the above must be remembered the frequent introduction and withdrawal of instruments, lithotrite and evacuators, and the result upon the neck of the bladder and the deep urethra. The evacuating lithotrite is very useful in such cases.

More important than the size of the stone is its composition. There is, of course, no comparison between a pure lithic acid or oxalate of lime stone on the one hand and an alternating stone with a good deal of phosphate or urates in its composition, as a test of skill and endurance both on the part of the surgeon and his instruments. Dr. Hingston, of Montreal,[3] in his article on Lithotrity, points out that sometimes the apparent softness of a stone is most misleading.

Having found an enormous stone in a patient, he employed lithotrity, as the stone seemed soft. After getting away a large quantity of phosphatic matter, he was driven to perform lithotomy, and removed, by the lateral method, a calculus weighing over 5 oz., consisting mainly of oxalate of lime and uric acid.

There are several other *fallacies in gauging the size and number of calculi.* Thus the lithotrite may again and again seize a stone which only weighs ½ oz. in its long diameter, if flattened, of two inches. Testing by passing a staff around or rubbing it over a calculus is often most fallacious, and examining per rectum may, if the bladder be thickened, give evidence of a stone apparently much larger than it really is. Careful and sometimes repeated X-ray examinations after emptying the sigmoid and rectum give the most reliable evidence as to the size, number, position, and composition of vesical calculi.

Very large stones, especially if dense and hard, are best treated by suprapubic lithotomy ; smaller hard stones can be removed by lateral lithotomy.

(4) **Condition of the urethra.** How far will the urethra *admit* instruments, *i.e.* how far is its canal normal or diminished by stricture. A stricture, if admitting of dilatation or internal urethrotomy, is not an obstacle to litholapaxy ; on the other hand, an old stricture with surrounding induration and fistulæ, or a less severe form which produces rigors and fever at each attempt of dilatation, are best submitted to lithotomy, which at the same time offers the much-needed relief of rest to the stricture. Mr. Cadge gives the following practical hints in these cases of stone combined with stricture : " Sometimes a stone is detected in the urethra behind the stricture, as well as one or more in the bladder, or it may be partly in the bladder and partly in the urethra, and in these

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[1] *St. Thomas Hospital Reports,* 1891.   [2] *Loc. infra cit.*
[3] *Intern. Encycl. of Surg.,* vol. vi, p. 311.

cases median lithotomy will not only remove the stone, but may go far to remedy the stricture by external division."

(5) **Condition of the prostate.** An enlarged prostate is of great importance, not only from its power of obstructing the operation, but from the changes which it brings about in the bladder. Thus, it interferes with the efficient use of instruments, the picking up of a stone even with the blades reversed, and the finding of the last fragment. Again, the use of the lithotrite and the passage of evacuating tubes readily lead to hæmorrhage, and this again by clots prevents the free and easy use of the evacuator. Later on, phosphatic deposit, imperfect evacuation, residual urine, and recurrence of stone symptoms are all frequent accompaniments of enlarged prostate. Therefore suprapubic cystotomy should be adopted, so that the chief cause of trouble, the enlarged prostate, can be removed.

(6) **Condition of the bladder.** Some changes [1] in the bladder require mention. (*a*) When the bladder is so irritable and contracted that it will not admit the two or three ounces of water which are necessary for safe crushing, some form of lithotomy must be adopted. (*b*) Sacculation pouches or sacs, whether mere hollows behind or at the sides of an enlarged prostate, or hernial protrusion of the mucous membrane between the muscular fibres, may be the starting-point of calculus by entangling debris or tiny fragments. In Mr. Cadge's words : " The imprisoned fragment first fills up the cyst, then, by continual accretion of phosphates, it grows up into the bladder like a mushroom, and is probably again and again nibbled off by the lithotrite, each time with temporary benefit, until the patient dies, worn out with chronic cystitis and pyelitis." Mr. Cadge goes on to say : " By turning the aperture of the evacuating catheter towards these pouches, and by the free use of the aspirator in all directions, the fragments may be washed out of them and all removed, but it cannot be denied that it is always a serious matter to shatter a stone into innumerable fragments in a bladder of this description." Suprapubic lithotomy is strongly indicated when a stone is in a diverticulum or sacculus, as shown by radiographic or cystoscopic examination or strongly suggested by other evidence. (*c*) Atony, whether with or without an enlarged prostate. The importance of this is obvious, as tending to recurrence of stone by some small fragments not being expelled in spite of the vigorous use of the aspirator, and also to cystitis from imperfect emptying of the bladder. (*d*) When a growth coexists with stone suprapubic cystotomy is indicated.

(7) **Condition of the kidneys.** Here I may again quote a veteran's opinion, that of Mr. Cadge : " What is to be said of stone complicated with kidney disease, such as albuminuria and chronic pyelitis and atrophy ? In these cases all operations are fraught with danger, but it is probable that the least danger will be met with from a carefully conducted one-sitting lithotrity. So, too, in those cases of constitutional disease combined with stone, such as diabetes, tabes, and other spinal disease, it will be well to avoid the shock and hæmorrhage of lithotomy,

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[1] Several allied conditions exist in which the position of the stone is complicated with difficulties, *e.g.* (1) where the stone has been partly in the bladder and partly in the urethra. (2) The stone has been lodged entirely or partly in a diverticulum of the bladder. (3) The stone has been lodged in a deep pouch behind the prostate. For helpful information on these and many other points I would advise my readers to consult Mr. H. Milton's paper on " Lithotrity in Cases of Stone, Simple and Complicated," *Lancet*, April and May 1896.

and proceed, if any surgical proceeding is allowable, by lithotrity."
The surgeon, in considering an operation in any of the above diseases,
will weigh well the size of the stone, his ability to cope with it at one
sitting, and the amount of suffering which it causes the patient.

(8) **Age.** Litholapaxy is difficult in young male children, and its
mortality in them is about the same as that of lateral lithotomy, so that
unless the surgeon is a skilful crusher he should adopt lateral lithotomy.

(9) **The risk of recurrence.** As no one, to my knowledge, has
spoken out on this subject with such helpful candour as Mr. Cadge, with
his experience of 300 cases of stone, I make no apology for quoting
once more from his writings : [1] " Although the immediate and direct
mortality of lithotrity is small, the recurrence of stone is lamentably
frequent. In my own list of 133 cases, there were eighteen in which
recurrence, one or more times, took place, being about one in seven. Sir
H. Thompson, with a much larger number of cases, gives about the same
proportion. I am disposed to infer, however, that recurrence is more
frequent even than this, because it is not likely that all who get relapse
apply to the same surgeon again. Living, as I do, in a local centre, and
drawing cases chiefly from a limited area, I am probably more able to
trace, and more called on to treat those who suffer a second and third
time, than he who lives in the metropolis and draws his cases from great
distances. Patients may, and frequently do, apply to the same operator
once or twice ; but, after a time, they either apply to their own surgeon,
or they decline further treatment, and too often their subsequent history
is one of painful endurance of chronic bladder disease and gradual
exhaustion. If, moreover, there be added to the list those numerous
cases of phosphatic deposit or concretions so frequently noticed after
lithotrity, the relapses would, I believe, reach to nearly 20 per cent. This
seems a heavy indictment to bring against lithotrity, but I am afraid there
is no gainsaying it ; and, if so, it would be wrong to pass it over or make
light of it. Many of these relapses might be prevented if the patients would
observe directions and persevere with treatment. It certainly is so
with the unenlightened and uncomplaining hospital patient. Feeling
himself well, or what he considers well, he goes to his work, and neglects
the use of the catheter and other means ; and, instead of returning in a
month or so to have his cure certified, or a minute remaining fragment
removed, he toils away as long as he can, and returns, perhaps in a year or
two, with a fresh uric-acid stone, or with chronic cystitis and a phosphatic
one. The educated, sensitive private patient, on the other hand, will
watch his symptoms narrowly, and return if the slightest indication of the
old mischief should reappear. . . . This frequent recurrence must
be due either (1) to the descent of a fresh stone from the kidneys, or
(2) to a fragment of stone having been left at the first operation. As
to the descent of a fresh stone : there can, of course, be no doubt as to
the occasional occurrence of this cause, just as we see it occur after
lithotomy. The bladder being entirely cleared of stone, there will be the
same liability to the descent of a fresh renal calculus after one operation
as after the other. What then, let me ask, is the fact as to lithotomy ?
I have already shown that there were only twenty-one cases out of more
than 1000 of lithotomy at the Norwich Hospital in which recurrence was
clearly traced to perfectly fresh formations, coming, like the first, from
the kidney, or about one in fifty ; whereas, in Sir H. Thompson's list of

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[1] *Brit. Med. Journ.*, July 3, 1886.

about 600 persons treated by lithotrity, he mentions sixty-one cases in which he operated twice; nine, three times; three, four times, and two, five times—seventy-five in all, or about one in eight. The inference from these data seems to me to be inevitable, that relapse of stone after lithotrity is chiefly due to other causes than the descent of a fresh stone. To my thinking the majority of recurrences is caused by the great difficulty in ensuring the complete removal of all the debris; I have already referred to this in old persons with enlarged prostates and feeble atonic bladders, and it is this class of patients who are especially liable to relapse." Mr. Cadge goes on to show that the tendency to phosphatic deposit after lithotrity is not due to vesical incompetence and residual urine alone without some overlooked fragment, and that the improved method with repeated washings will still fail to discover a last fragment in some bladders. At the present time the cystoscope and the evacuating lithotrite should do much to prevent fragments from being overlooked and left in the bladder.

More recently Mr. Reginald Harrison has given [1] an analysis of 110 operations for stone, 101 of which were litholapaxies. Recurrence, necessitating further operation, took place twenty-three times, *i.e.* in nearly 23 per cent., a considerably greater proportion than Mr. Cadge gives. *In all but one case the recurrence was associated with enlarged prostate, for which litholapaxy is contra-indicated.* Mr. Harrison considers that this is accounted for in several ways, partly by the fact that debris may be left behind in sacs and pouches at the time of operation, and partly owing to the inability completely to empty the bladder later, so that fresh stones descending from the kidneys are retained while other foreign bodies, such as shreds and sloughs from an inflamed bladder, may form nuclei for the formation of fresh stones. With a view to preventing recurrence in these cases, the author lays great stress on the importance of thorough washing out at the time of operation, also once a week for three or four months after the operation, and also of the adoption of measures aiming at the reduction of the size of the prostate. At the present day it is best to enucleate the prostate (unless there is some grave contra-indication) and thus remove the chief cause of the stone-formation and recurrence.

LITHOLAPAXY

Preparation. The patient is kept at rest for a few days on a light farinaceous and liquid diet. If there is cystitis 10 grains each of urotropine and acid sodium phosphate should be given three times a day. The bowels are regulated with mild aperients and an enema about three hours before the operation.

Instruments. Lithotrites of various sizes and character are required according to the size of the urethra, and the size and hardness of the stones to be crushed. The female blades should be fenestrated so that debris cannot accumulate in the instrument, and the locking action should be simple and easy. Those of Freyer and Milton are good. Freyer's combines the separate virtues of the older instruments of Thompson and Bigelow. Milton's evacuating lithotrite avoids much changing of instruments and urethral damage in troublesome cases. It is well to have several evacuators prepared so that they may be used alternately to save time. Those of Freyer and Milton are very simple

[1] *Lancet,* November 12, 1899.

and convenient; the rubber of the latter stands boiling and as it is attached by a metal clip there are no joints to get out of order. The cannulæ should be slightly curved and vary in size between 6 and 18 English scale. They should have stylets. Conical steel sounds from 6 to 18 should be at hand, for the urethra may need dilating to admit a suitable lithotrite.

Operation in Adult Males. The patient is anæsthetised on a firm, narrow and rather low table. His pelvis is raised by a firm flat cushion so that the stone falls back from the neck of the bladder to the wider base where it can be more easily and safely crushed. The body and limbs are well protected from chill, the latter by very long woollen stockings. The thighs are flexed and somewhat abducted. The surgeon stands on the right with all his sterilised instruments close to him. The bladder is washed out and three ounces of sterilised water are left in. Too much water makes the operation far more difficult. When there

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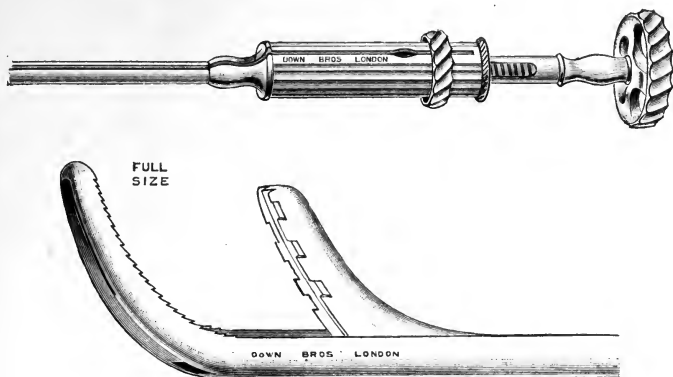
FIG. 266. Milton's lithotrite.

is no cystitis the patient may be asked simply to empty his bladder an hour before the operation, for then about two to three ounces of urine will have accumulated by the time he is under the anæsthetic. When the meatus is too small it must be enlarged downwards with a scalpel introduced into it. When the urethra is small or a very large lithotrite is to be used, conical steel sounds are introduced to dilate it. The lithotrite is accurately closed, locked, well lubricated and held horizontally in the right hand with beak entering the urethra as the penis is drawn forwards by the left hand.

In introducing the lithotrite care must be taken not to get the beak hitched either just in front of the triangular ligament or on the roof of the prostatic urethra. This will be secured by not depressing the instrument till very late—in fact, not till it is just about to enter the bladder. The instrument, well warmed and oiled, is held at first horizontally over the groin or abdomen, the penis being drawn over it, the shaft being all the time gradually brought into the vertical position as the instrument finds its way by its own weight into the bulbous, membranous, and prostatic urethra. Now, and not before, the handle is somewhat depressed, and the instrument glides quickly into the cavity of the bladder. If the prostatic urethra is enlarged and lengthened, the surgeon may think that he has reached the bladder, but the fact that the gentlest lateral

movement of the lithotrite is interfered with will show him his mistake. Pressure with the instrument is alone allowable at the meatus ; some rotation may be called for in guiding the instrument through the triangular ligament or past an enlarged prostate.   In this latter case also the handles must be further depressed, and a finger in the rectum may give help.

When the lithotrite has entered the bladder it should be allowed to slide, very gently, down the trigone, being now held very lightly so as at once to detect the site of the stone, which it now often touches, but must not displace.

If the stone is felt on one side, the instrument is gently turned to the opposite one, opened, and then turned towards the stone.   If it be not felt, the handle of the instrument being slightly raised, and the blades very gently depressed and then opened, the stone will often drop into them.
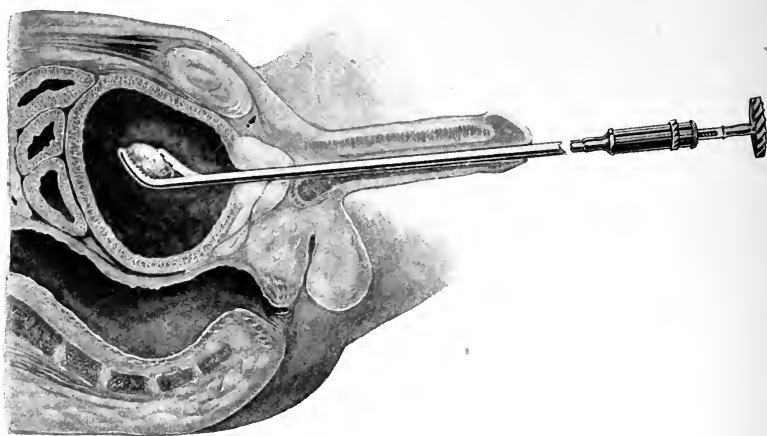
Fig. 267.   Litholapaxy.   The stone is brought forwards into the middle of the bladder, and the jaws of the lithotrite are rotated forwards before crushing is commenced.

If this fail, the instrument is turned, open, first obliquely, then more horizontally, first to the one side, then to the other.   In the event of the stone still eluding the lithotrite, which is most unlikely, it should be sought for with blades depressed.   To effect this, the blades, closed, are raised off the bladder floor by depression of the handle, carefully reversed, and then depressed again so as to sweep lightly over the floor. They are then gently opened and closed, vertically first and then obliquely, so as to complete the examination.

During the above, the following points must ever be borne in mind :

(a) The handle and shaft of the lithotrite are to be kept as steady as possible, so as not to jar the sensitive neck of the bladder needlessly. (b) All movements are to be executed at or beyond the centre of the vesical cavity, the proper area of operating, without hurry, rapid movement [1] or any other which partakes of the nature of a jerk or concussion.[2]

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[1] " Rapid movements produce currents which keep the stone more or less in motion, so that it is less easily seized than when the surrounding fluid is in a state of rest " (Thompson).

[2] Sir H. Thompson, *loc. supra cit.*, p. 296.

(c) The male blade is never to be brought into contact with the neck of the bladder, unless this is rendered necessary by the position of the stone.

The stone being seized by one of the above manœuvres and the screw connected—the screw is gradually turned at first to make the jaws bite, since a sharp turn at this time may drive the stone out either to right or left—the calculus is then carried to the centre of the cavity, which will show whether a fold of mucous membrane has been seized (Fig. 268). As the screw is applied more and more · forcibly, one or other of the following will be noticed. If not well caught and if hard, the stone will be pushed out of. the jaws ; if hard and well gripped, it is felt to split into fragments ; if soft, and held, it crumbles down. If extremely hard, as a pure lithic acid or oxalate, any attempt at advancing the screw is met by this distinctly recoiling instead of
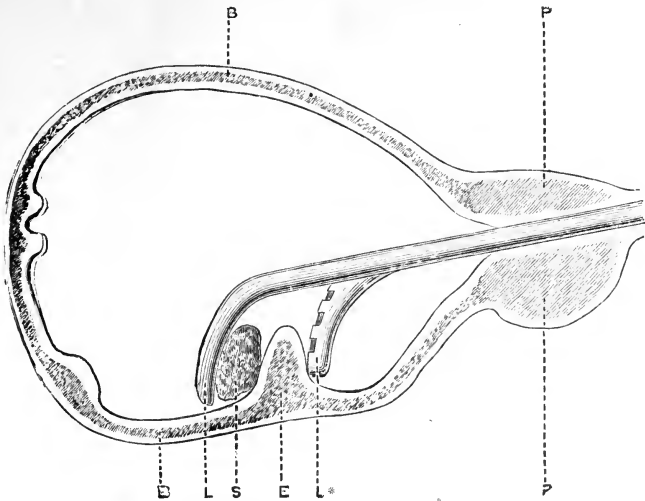
Fig. 268. This shows a risk present in operating in trabeculated bladders. While the female blade (L) is in direct contact with the stone (S), the male (L*) is in contact with a ridge of the mucous membrane (E). B, Bladder. P, Prostate. (R. Harrison.)

advancing. Each surgeon must now decide for himself, according to his knowledge of his instruments and reliance on his power to deal with large, hard fragments, whether to continue or at once to perform lithotomy. If he continue, the resistance will be felt to give way, in the case of a very hard stone, by a sudden sharp crack ; in one less hard, more gradually. If the stone does not crack, Freyer [1] advises that the lithotrite be unscrewed, the stone caught in another axis, and the lithotrite again screwed home. By repeating this, if necessary, the stone will usually at last give way. The same surgeon also recommends that in dealing with stones which are more or less round and so large that the lithotrite will not lock in any direction, the jaws of the instrument should be dug into one side of the stone and screwed up, a portion of the crust being thus broken off. By repeating this a number of times, sufficient reduction in size will take place to allow of the lithotrite being locked on the stone. In overcoming much resistance the surgeon either screws up

[1] *Loc. supra cit.*

the male blade as hard as he can and keeps it so, or, having gently unscrewed it a little, screws it up again with a series of light jerks so as to communicate blows to the stone. Cracking of the stone having taken place, the fragments will usually fall close to the original site. Thus the lithotrite has only to be kept as immovable as possible to ensure, on drawing out and again closing the male blade, the seizure of a fragment.[1] This is crushed, and the process repeated again and again until all the fragments have been well crushed, so that the instrument need not be reintroduced. The lithotrite is then withdrawn firmly screwed up.

A straight or curved evacuating tube, No. 16 for a stone of moderate size, and 18 for a large one, is then introduced, the evacuator, filled with a warm solution of boracic acid, is connected, the meatus being first incised with a narrow probe-pointed bistoury downwards by the side of the frenum, if needful. The tube, if curved, should be held downwards at first, but not quite on the bladder floor ; then to one side or the other ; then upwards, washings being carried on at the time that these movements are made. A straight tube should lie with its orifice just within the neck of the bladder. Dr. Keyes[2] gives this precaution as to getting rid of air entirely : " The urine, having trickled away through the tube, leaves the latter full of air, an element fatal to nicety of washing. This air may be disposed of most simply. The tube is withdrawn until its eye is in the prostatic sinus, the washing-bottle is attached, and the stop-cock turned, but no further suction made. In an instant, the air contained in the tube is heard ascending through the stop-cock and mounting into the top of the evacuator, where it does no harm, and whence it cannot possibly return into the bladder." While his left hand supports the evacuator, with his right the surgeon gently but quickly squeezes the bag with sufficient force to send in about two ounces of fluid. On relaxing the pressure an outward current takes place, bringing with it crushed fragments. Sir H. Thompson recommends that, after the bag has expanded and the current apparently ceased, the surgeon should wait a few seconds, " as at that precise time it is quite common for one or two of the larger fragments to drop into the receiver which would have been driven back, perhaps, by too rapidly resuming the pressure."

FIG. 269A. Milton's evacuator.
(Down Bros.)

If, after several washings, the outflow stops, and the bag no longer expands, the end of the evacuator is blocked either by a fragment of stone, or a small calculus, a clot of blood, or the mucous membrane of the bladder. If it be a fragment, as is usually the case, or a clot, dislodgment may be effected by sending in quickly a gush of fluid, or by the use of a stylet, after unscrewing the tube. Impact of the bladder generally takes place when a curved evacuator is turned upwards, and when the bladder is empty. The sensation given may be a kind of flap, simu-

[1] It is not always easy to distinguish between a piece of soft stone enveloped in inspissated mucus and the lining membrane of the bladder.
[2] *Intern. Encycl. of Surg.*, vol vi, p. 244.

lating the click of a fragment; more often it is a dull, vibrating thud, easily recognised. More fluid must be at once injected.

If a large fragment is felt striking against the tube, or if the surgeon is certain that several good-sized fragments remain, he removes the tube and evacuator, and, while an assistant withdraws the blood-stained fluid and fragments, and recharges the evacuator, he introduces a small lithotrite and crushes up sufficient debris to go on again with the washings.

All the time the surgeon must keep before his eyes a mental picture of the interior of the bladder, perhaps diseased, the ureters, perhaps dilated, leading up to kidney pelves enlarged, and remember that the effects of any squeeze of his hands are felt, not only all over the bladder, but perhaps in the ureters and kidneys as well.

Detection and Seizure of the Last Fragment. This is, as is well known, a matter of much difficulty, owing to the facility with which small fragments get hidden in some folds of mucous membrane or enveloped in blood-clot. As long as there is any " clicking " against the tube, the surgeon must persevere in his attempts at complete removal. If, after several washings, nothing comes out into the receiver, the surgeon should listen carefully over the bladder, as thus advised by Dr. Keyes : [1] " The tube is turned in various positions, and the operator

Fig. 269B.   Curved evacuating tube.   (Down Bros.)

listens. The swish of the water as it rushes in and out is heard with startling distinctness, and, if the management of the tube is skilful, any fragment of stone lying loose in the bladder is sure in a short time to be driven against the metallic tube so as to announce its presence by a characteristic click, quite distinct from that emitted by the flapping of the bladder wall against the eye of the instrument. Fine sand and thin scales of stones make no sharp click, and all such may be left to pass by Nature's efforts, but any piece large enough to require the lithotrite can hardly escape detection by the educated ear."

Time occupied in Litholapaxy. This may be, on an average, from half an hour to an hour and a half. Prof. Bigelow [2] operated continuously for upwards of three hours, removing 744 grains, the patient making a good recovery. Mr. R. Harrison [3] removed a two and a half ounce stone in two hours and ten minutes.

After-treatment. The chief points here are : rest in bed, the patient turning on his side to pass water, for the first few days ; hot fomentations to the abdomen and perineum, and hot bottles at first ; morphia subcutaneously, if indicated ; warm milk, barley-water, mineral waters or lemonade, a little whisky or brandy being given, if needful ; all chills should be carefully avoided. Mr. Milton [4] recommends salicylate of

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[1] *Loc. supra cit.*, p. 246.   The whole of this account, with its vigorous life-like language, will well repay perusal.

[2] *Amer. Journ. Med. Sci.*, January 1878.

[3] *Brit. Med. Journ.*, August 10, 1882.   [4] *Loc. cit. supra.*

soda at first every two and then every four hours if there is fever, and diuretin if there is diminution of urine. In each case the amount given is one gramme. If cystitis is present, urotropine in doses of 10 grs. thrice daily should be given.

In addition to the above, putting the patient frequently in hot hip-baths for a quarter of an hour, the occasional passage of a soft catheter, and rendering the urine alkaline, will give much relief.

Complications during Litholapaxy. (1) *Escape of Urine.* This may take place during or after the passage of the lithotrite. The penis should be compressed against the lithotrite, and a pause made while the patient is got more fully under the anæsthetic. If this fail, tying a tape round the penis and instrument, injecting a little fluid, or putting off the operation till the bladder is in a more fitting state after the use of instruments, injections, and such drugs as belladonna and subcutaneous injections of morphia, may be made use of.

(2) *Hæmorrhage.* Sufficient blood to stain the fluid in the evacuator during the operation, and the urine for a day or two after it, is not uncommon. If the hæmorrhage during the operation is severe, the surgeon must decide whether it is due to the damage to the bladder or urethra, to his having scratched the latter by withdrawing a fragment in the evacuator's eye, to bruising of an enlarged prostate, or to co-existent growth. In this last case the suprapubic operation will probably have to be performed either at the time or later ; in the other cases the surgeon must decide on completing or deferring the crushing by the amount he has already effected, his experience, and the amount of the bruising inflicted.

(3) *Clogging or Fracture of the Lithotrite.* Clogging or impaction is liable to happen with a non-fenestrated instrument with weak and narrow blades. With one properly made, with as broad blades as possible, and the male one blunt, roughened, and laterally bevelled off, the accident is unlikely. When it occurs, it must be met by percussing the instrument, if opening and closing the blades, and thus freeing them in the fluid, is impossible. If a blade break off, it must either be caught and withdrawn by another lithotrite, or removed by suprapubic cystotomy at once.

(4) *Injury to the Bladder or Urethra.*

Complications after Litholapaxy. These are much the same as those as occurring after lithotomy. The chief differences are the greater liability to rigors and urinary fever, and the greater frequency of epididymitis. Bruising of the urethra has also to be remembered, whether by the instruments, or, after the old-fashioned lithotrity,

PERINEAL LITHOLAPAXY

This operation—first suggested and carried out by Dolbeau—consists essentially of lithotrity carried out through a small median or lateral perineal incision.

Surgeon-Major Keegan [1] observes " that experience has taught that suprapubic lithotomy has not fulfilled the early promise of the days of its revival, for the mortality which has followed it in cases of very large calculi occurring among males at the middle period of life is very considerable. There is, therefore, a growing consensus of opinion among surgeons practising in the East, where cases of very large calculi are of frequent occurrence, that perineal lithotrity, whether median or lateral, will in

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[1] *Brit. Med. Journ.*, vol. ii, 1897, p. 23.

the near future supersede suprapubic lithotomy in dealing with this very important class of cases of stone in the bladder." Reginald Harrison [1] also recommends the operation, having performed it fifteen times without a death or recurrence. In one case a very hard urate stone, weighing over three ounces, was crushed and removed in about five minutes, an enlarged middle lobe of the prostate being removed at the same time.

Some of the chief points claimed in favour of this operation are: (1) Large stones may be crushed in a short space of time. (2) An enlarged prostate may be dealt with at the same time. (3) It may be performed in cases of stricture or enlarged prostate. (4) It is less severe than the suprapubic operation. (5) Excellent drainage is provided in cases of cystitis, &c. (6) Digital examination can be made use of to determine whether all the fragments have been removed.

Before it can be decided, however, whether this operation should supersede the suprapubic operation, further experience must be awaited, particularly with regard to the important question of recurrence.

Operation. A small median or lateral perineal incision is made on a grooved staff, as in lithotomy, sufficiently large for the introduction of the finger into the bladder for the purposes of examination. The "giant" lithotrite specially devised by Mr. Keegan [2] is then introduced into the bladder and the stone crushed as in ordinary lithotrity. The fragments may be removed either by means of forceps or an aspirator connected with a specially large evacuating cannula. A tube is then introduced into the bladder through the wound for purposes of drainage.

Mr. Keegan says that the specially strong "giant" lithotrite devised by him, which is of the size of a No. 20 catheter in the stem and of No. $25\frac{1}{2}$ at the angle, "will readily break up a hard calculus weighing six to eight ounces."

LITHOLAPAXY IN MALE CHILDREN

The advisability of this mode of treating stone has been strongly advocated by Surgeon-Major Keegan,[3] who, after a wide experience of large stones in India, is inclined to think that the objections usually made to litholapaxy in boys are not valid. Thus: (1) as to the *smallness of the bladder*, the bladder of a boy of even only three or four is, as a rule, quite roomy enough to permit of the efficient working of a small lithotrite and a medium or full-sized aspirator if gently worked. The bladders of boys with stones are, as a rule, healthy, and will stand more distension proportionately to their capacity than the bladders of old men. (2) *The extreme sensitiveness of the mucous membrane of the bladder and urethra.* Mr. Keegan thinks that, with an anæsthetic, this may be safely disregarded. (3) *The liability to laceration of the mucous membrane of the bladder and urethra.* This objection is, he thinks, a theoretical one only. (4) *The small calibre of the urethra.* Mr. Keegan states that not only is the calibre of the urethra in boys of six or eight not very small, but that of boys of only three or four is sometimes very large. As in men, the true calibre of the urethra cannot be told unless the meatus, which is sometimes very small, is incised. Speaking generally, the urethra of a boy from three to six will admit a No. 7

[1] *Brit. Med. Journ.*, December 12, 1896.
[2] *Loc. supra cit.*
[3] *Litholapaxy in Male Children and Male Adults* (Churchill, 1887); *Lancet*, 1886.

or a No. 8 lithotrite (Eng. scale), and that of a boy of eight or ten will admit a No. 10, a No. 11, and even sometimes a No. 14. " With a No. 8 lithotrite and a No. 8 evacuating catheter it is, I find, quite feasible to dispose of a mulberry calculus weighing between two and three hundred grains in an hour's time."

In a later publication [1] Mr. Keegan gives the results of a series of 500 litholapaxies in boys. He says : " Grouping the 500 litholapaxies together, the work mainly of three surgeons, I find that the average age of the boys operated on was six years, the average weight of stone removed at each operation was ninety-five grains, and the stay in hospital after operation amounted to four days. The mortality, as already stated, was 41, or 2·2 per cent." Of the 500 operations, Mr. Keegan did 239, and lost 5 cases, the cause of death being extensive kidney disease. Mr. Keegan had constructed by Messrs. Weiss a No. 3½ lithotrite, which has done very good work, and advises any one wishing to give litholapaxy in boys a fair trial to provide himself with a set of completely fenestrated lithotrites running from No. 4 to No. 10 (Eng. scale).

Mr. Keegan insists upon the completely fenestrated lithotrite as being the only perfectly safe instrument to use, as, with any other, clogging of the blades is a very likely and a most dangerous complication.

In discussing, in the first edition of this book, the advisability of surgeons adopting, as a general rule, this method of dealing with stone in male children, I pointed out (1) that one very important matter, the percentage of recurrence after litholapaxy at this age, had been left undealt with by Mr. Keegan ; and (2) that such an individual experience, splendid as it is, can scarcely be taken to furnish a rule to those who only meet with stone at comparatively rare intervals. Mr. Keegan has written on both these points.[2] If will be seen that, with regard to the first point, the fact that recurrence after litholapaxy in boys in India is so very small, is due to the opportunities and experience, absolutely unrivalled and never to be known in this country, which fall to the lot of surgeons in India in treating stone in the bladder. Complete evacuation of fragments is much more difficult and uncertain in children owing to the weakness of the return stream through the small cannula ; this makes recurrence more likely in children. With regard to my second point, that such an individual experience, so different to anything that we meet with here, should not mislead those who only meet with stone at comparatively rare intervals to substitute litholapaxy for the eminently safe operation [3] which lateral lithotomy has been proved to be in boys, Mr. Keegan, writing as follows, confirms my opinion : " I am disposed to agree with Mr. Jacobson in doubting if in Great Britain lithotomy in male children will be replaced by litholapaxy. And why ? Because to render himself familiar with the use of the lithotrite, the surgeon must be afforded frequent opportunities of dealing with cases of stone ; and as such opportunities occur only at rare intervals to the majority of hospital surgeons in Great Britain, they will therefore very naturally cling to that

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[1] *Ind. Med. Gaz.*, August 1900.   [2] *Ibid.*, February 1890.

[3] Mr. Bryant, in writing of the successes which lateral lithotomy has given in children (*Surgery*, vol. ii, p. 106), states that during seventeen years 100 patients had been cut consecutively at Guy's without a death. Another matter deserves mention. Cutting for stone is no longer limited, as of old, to a few great centres. How many institutions in or out of London, how many cottage hospitals, will be provided with the set of special instruments which are necessary ?

operation which is performed by aid of the instrument with which they are most familiar, the scalpel."

Owing to the infrequency of calculus in children at the present time, and the fact that, as a rule, isolated cases—and only successful ones—are alone published, it is very difficult to speak definitely about the results of litholapaxy in children in European surgery. I would call the attention of my readers to a paper by Alexandrow.[1] This surgeon performed lithotrity thirty-two times in boys between 1 and 14 years of age in a children's hospital at Moscow. In twenty-seven the operation was successful; the remainder were fatal, and in three death occurred from injury to the urethra during the operation. Mr. E. Owen, with praiseworthy candour, brought a case before the Medical Society[2] in which fatal rupture of the bladder had taken place during litholapaxy in a boy aged 4. Litholapaxy is risky in children, and entails the presence of special and expensive instruments, and always at any age must risk leaving fragments which may lead to recurrence.

TREATMENT OF STONE IN THE BLADDER IN THE FEMALE

Practical Points. The absence of any prostate or of a fixed smooth trigone-surface is of importance here, especially with regard to litholapaxy. The aid given by a finger in the vagina, the dilatability of the urethra, the association of calculi with foreign bodies, are also well known. It is only occasionally that enlargement of the uterus or prolapse of the vaginal wall of the bladder interferes with the treatment of stone.

Operation. A. *In Adults.* We have here the following three methods to consider :

(1) **Dilatation.** When the stone is small—*i.e.* the size of a filbert, a stone not exceeding three-quarters of an inch in its largest diameter—it may be safely removed after rapid dilatation with Kelly's dilators, followed by a finger (the little one first).

It is not meant by this that much larger stones have not been successfully passed and removed from the female bladder. Thus, Dr. Yelloly[3] gives a case in which a stone, weighing 3 oz. $3\frac{1}{2}$ drs., was extracted : incontinence followed. Where large calculi, *e.g.* of 6 oz., have come away spontaneously, it has been usually by a process of prolapsus and ulceration combined. We do not yet know what is the greatest dilatation which the female urethra will safely bear. Perhaps the limit given above is, if anything, too small. Erichsen[4] gives " 8 or 10 lines in diameter " as the size of a stone which can be safely extracted by this means. Sir H. Thompson[5] says, " dilatation should never be employed for any calculus larger than a small nut or a large bean in an adult, which limits its application to very few cases." Mr. Bryant[6] states that, " in children, a stone three-quarters of an inch in diameter, and in adults one inch, may be fearlessly removed from the bladder by rapid dilatation and extraction, with the patient under the influence of chloroform. I have removed larger calculi, two inches in diameter, by this means, without any injurious after-effect, but it is probably not wise to make the attempt, the surgeon possessing in lithotrity an efficient aid or substitute." Dr.

[1] *Deut. Zeit. f. Chir.*, 1891, Bd. xxxii, Hft. 5, S. 6.
[2] *Lancet*, 1891, vol. i, p. 665.
[3] *Med.-Chir. Trans.*, vol. vi, p. 574.
[4] *Surgery*, vol. ii, p. 1024.
[5] *Syst. of Surg.*, vol. iii, p 308.
[6] *Surgery*, vol. ii, p. 120.

Keyes [1] recommends not dilating the urethra more than three-quarters of an inch.

(2) **Litholapaxy.** By this means calculus in the female bladder may be most frequently and efficiently treated. Thus, hard stones under two ounces and phosphatic ones of a much larger size, may be dealt with at one sitting. The character of the ring or sound with the staff, the bite of the lithotrite, the cystoscope, and the condition of the urine will aid here. A shorter instrument will be found much more convenient to work with. Where there is much irritability of the bladder, much difficulty will be met with in keeping fluid in it, owing to the absence of a prostate and the shortness and directness of the urethra. The pelvis must be well elevated, the patient placed fully under the anæsthetic, and the finger of an assistant should make pressure on the urethra. In other respects the operation resembles that already fully given for the male (p. 641). The dilatable urethra admits a large evacuating tube.

(3) **Lithotomy.** This operation is called for when the stones are multiple,[2] when one is large, especially if mainly hard as well, when there is a foreign body as a nucleus,[3] when there is great irritability with ulceration of the bladder, or when a growth co-exists.

Of the following methods—(a) vaginal, (b) suprapubic, (c) urethral, and (d) the lateral method of Buchanan—the first two only need be alluded to.

Vaginal Lithotomy. By this is meant extraction of a stone through an incision in the anterior vaginal wall, behind the vesical orifice of the urethra, and thus not interfering with this canal at all.

This anterior wall is about four inches long in the adult; in relation with it anteriorly is the urethra, to be felt as a cord through this wall, behind this the bladder, and farther back the os and cervix uteri. No peritoneum is normally in relation with this wall, as this membrane leaves the uterus half-way down to pass directly on to the bladder. No important vessels or nerves are met with in vaginal lithotomy; but this, though the simplest and easiest of all the methods of cutting for stone, will be but rarely called for, as in all moderate stones in women litholapaxy is usually available, while in the case of larger ones, and with all calculi in female children, the suprapubic method is indicated, save for tiny stones which can be removed after dilatation. The only drawback of a vaginal lithotomy in women is the risk of a fistula, but this need only be taken into account where phosphatic urine is present, or where the edges of the wound have been bruised during the extraction of the stone. In either case the calculus will probably be a large one or multiple, a condition, as already stated, which is better dealt with otherwise. The following case, which came under my care in 1889, is a good instance of how the operation may be occasionally called for:

[1] *Intern. Encycl. of Surg.*, vol. vi, p. 297.
[2] As in Dr. Galabin's case (*Obst. Soc. Trans.*, April 7, 1880), in which twelve large calculi and about fifty smaller ones were removed successfully by vaginal lithotomy from the bladder of a woman aged 61.
[3] As in the large stone formed round a hair-pin, and figured (p. 579) by Hart and Barbour in their *Manual of Gynæcology.* Here the projection of the hair-pin on either side of the stone would indicate, nowadays, the suprapubic operation. Some of my readers may remember that a few years ago an inquest was held in London on the body of a girl who died with an undetected calculus in the bladder, which dated to a hair-pin. The sarcastic remarks of the coroner led to some correspondence in the papers, from which it would appear that these calculi are less rare than has been believed.

"Vaginal Lithotomy in a Patient Six Months and a Half Pregnant; Immediate Suture of the Wound—Recovery; Normal Delivery at Full Time" (*Lancet*, vol. i, 1889, p. 628). A. L., aged 27, was sent to me by Dr. Montagu Day, of Harlow, December 7, 1888. For three years she had had bladder trouble, viz. hypogastric pain, cystitis, very frequent micturition day and night, with stoppages of the stream, and acute suffering after the bladder was emptied. The patient was extremely timid and nervous, owing to her four confinements having been "tight" and lingering. Craniotomy had been required with the first, and, with another, labour was induced at seven months.—December 8. The urethra was dilated, and the bladder explored. A calculus, apparently an inch in either diameter, was felt; the bladder was extremely contracted with its mucous membrane in places raw and bleeding, in others encrusted with phosphates. It was decided, for the reasons given below, to perform vaginal lithotomy.—December 10. Twenty-four hours after the exploration the patient had recovered control over her bladder. The vagina was thoroughly syringed out with hydr. perch. (1 to 1000), the posterior wall was well drawn down with a duckbill speculum. A straight lithotomy staff (No. 4) was then passed, and the site of the stone determined. A sharp hook was next inserted into the posterior part of the urethra so as to drag the anterior wall of the vagina upwards and forwards. This, however, caused such free oozing that it had to be removed, and sponge-pressure applied. The bleeding was partly caused by the vascularity of the parts due to pregnancy, and partly by that set up by the dilatation of the urethra two days before. A sharp-pointed bistoury, introduced so as to avoid the urethra and neck of the bladder, was carried into the groove of the staff through the anterior wall of the vagina and fundus of the bladder, and then backwards for nearly two inches. The gush of urine which at once followed on the withdrawal of the knife carried the stone downwards, and it was extracted with lithotomy forceps with the utmost ease. After the bladder had been explored with the finger, it was repeatedly washed out from the wound [1] with diluted Thompson's fluid. Little bleeding had followed on the incision, and it was clear that sutures would entirely control what remained. The vagina having been well sponged out, the edges of the incision, clean cut and without bruising [2] were adjusted with six salmon-gut sutures and four of horse-hair. The apposition was tested with a fine probe, especially behind, where a little difficulty was met with in inserting the sutures. Owing to the patient's straining at this time, some urine escaped from the urethra, but none came through the wound. The vagina was next thoroughly syringed with a solution of hydr. perch. (1 in 3000), dried out with aseptic sponges, and dusted with iodoform. To secure more certain asepsis, and also to support the wound and sutures, the vagina was lightly plugged with strips of iodoform gauze. Though this was done with all gentleness, it was soon after noticed that blood was trickling from the vagina. On removal of the strips, two small lacerations on the right side of the vagina, near the orifice, the parts here being exceedingly pulpy and vascular, were oozing freely. This was arrested by tying up the bleeding points with chromic gut. The vagina was again irrigated and insufflated, but no further trial of plugging was made. As soon as the patient was replaced in bed, a soft catheter was inserted to empty into a "slipper." The recovery was rapid and without drawbacks. The ten sutures were removed on the eighth day with the aid of chloroform. The catheter was retained till the twelfth day, when the patient was allowed to get on a sofa. She left the hospital seventeen days after the operation. Dr. Day wrote, on March 19, that the patient had been safely confined without any trouble with the lithotomy incision.

The first question to decide here was whether to operate at once or to let the pregnancy (already advanced to six months and a half) be be first concluded. While the stone itself was not large enough to have interfered with labour, both Dr. Day and I thought that, if the bladder were allowed to remain in its present state for another two months and a half, the cystitis would be rendered much more difficult of treatment, intensified, as it was likely to be, by a lingering and difficult confinement, such as the patient was liable to. It having been decided that it was advisable to interfere at once, the choice lay between (1) *dilata-*

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[1] It would be wiser to do this from the urethra.
[2] Under less favourable conditions closing the wound may have to be deferred till the parts are quite healthy.

tion of the urethra, (2) *litholapaxy, and* (3) *lithotomy*. (1) *Dilatation*.
The size of the stone at once put this aside. Though small (240 gr.),
it was a full inch in one diameter, and just over three-quarters of an
inch in the other. With such a stone (a hard one, of lithic acid and
lithates), there was a very serious risk of after-incontinence (especially
when the blades of a small forceps have to be taken into consideration
as well). (2) *Litholapaxy*. If it had not been for the co-existing preg-
nancy, the stone might well have been thus dealt with. But as great
irritability of the bladder was present, in addition to the pregnancy,
it was thought that litholapaxy was more likely to require a prolonged
anæsthetic and to cause greater disturbance of some important pelvic
and abdominal viscera than the remarkably simple and rapid vaginal
lithotomy. It will be remembered that the way in which the anæsthetic
would be taken, and its after-results, were more than ever matters of
uncertainty in this case. If the anæsthetic had been badly taken, we
had to face the risks, on the one hand, of premature labour coming
on, and, on the other, of difficulty in completing the operation, and thus
of fragments being left behind, which would intensify the already existing
cystitis. (3) *Lithotomy*. It being decided to resort to this, the vaginal
method was chosen from its great simplicity, the small amount of anæs-
thetic required, and the facilities which it gave for washing out the
bladder at the time of the operation.

Suprapubic Lithotomy. This is described at p. 661. The fluid is
retained in the bladder by finger-pressure upon the orifice of the urethra.

B. *In Children*. Some of the conclusions which Mr. Walsham has
drawn in a very helpful paper [1] may be quoted here :

For small stones rapid dilatation under chloroform is better, as
causing less annoyance and inconvenience to the patient. That moderate
and even large-sized stones have been removed by dilatation, but that
as incontinence has frequently followed from over-distension, it is not
justifiable to subject the patient to this risk. That, after limited dilata-
tion, should the stone appear larger than was anticipated, it may be
crushed with safety ; but, should crushing be considered unadvisable or
impossible, it is better to perform vaginal lithotomy than subject the
patient to any risk of incontinence by over-dilatation. That it is not
safe to aid the dilatation by incising the urethral walls. That incision
of the urethra alone, without dilatation, in whatever direction practised,
is frequently attended with incontinence, and should therefore be aban-
doned. That moderate and even large stones can be easily removed from
young children by vaginal lithotomy, aided, if necessary, by dilatation of
the vagina, incision of the fourchette, and crushing of the stone by the
wound made through the septum, without any risk of a permanent
vesico-vaginal fistula so long as the edges of the incision are not bruised
in the extraction.

Mr. Walsham considers each of the above and several other points
separately, and supports them with evidence. I think that this tends
to show, in the case of vaginal lithotomy, that, though a stone may be
thus extracted after dilatation of the vagina, division of the fourchette,
and destruction of the hymen, it is by no means easy in these cases to
insert sutures satisfactorily. It will be wiser, I think, to make use of
the suprapubic operation in female children for large stones. Lithola-
paxy, although by no means easy in these small bladders is, however,

[1] *St. Bartholomew's Hospital Reports*, vol. xi, p. 129.

held by Mr. Keegan [1] to be the correct treatment in the great majority of cases of vesical calculus in women and girls.

I would refer my readers to a case of suprapubic operation by Mr. Barwell in a child, aged 9, from whom a stone weighing two and a quarter ounces was successfully removed. It is interesting to note that Mr. Barwell was led to adopt the suprapubic operation from his having had within seven months no less than three cases of vesico-vaginal fistulæ originating in the extraction of calculi during infancy and youth by different surgeons.[2]

LATERAL LITHOTOMY (Figs. 270, 271)

Owing to the introduction and perfection of the crushing operation for stone, and the popularity of the suprapubic operation for larger stones, lateral lithotomy is now seldom performed. The chief indications are—(1) In children, when the stone is a small one, and when the surgeon is inexperienced in the use of the lithotrite, it is the operation of choice as it has a very low mortality. (*See* also the remarks on pp. 647, 648.) (2) In the case of a large stone with which it has been decided to deal by perineal lithotrity (p. 646) the bladder is opened by the same steps as in lateral lithotomy. (3) In certain cases of stricture of the urethra and enlarged prostate, where a staff can be passed. In the majority of the cases of enlarged prostate, however, the suprapubic method is to be preferred, as by this means the prostatic hypertrophy can be more readily dealt with at the same time, and the bladder more thoroughly examined, especially as regards the presence or absence of diverticula which may contain stones (p. 669). Preliminary cystoscopy and radiography are always indicated.

The lateral operation will be described under the following heads :
A. **Preparatory Treatment.**
B. **Passing the Staff. Possible Difficulties.**
C. **Finding the Stone. Possible Difficulties.**
D. **Entering the Bladder. Possible Difficulties.**
E. **Extracting the Stone. Possible Difficulties.**

A. **Preparatory Treatment.** For a week or so before the operation the diet should be bland, so as to tax as little as possible the jaded kidneys, *e.g.* milk, barley-water, light puddings, and a little fish. Baths should be taken regularly, the bowels well moved, and an enema given on the morning of the operation, and care should be taken that all this has come away. The bladder is washed clean, and six ounces of boracic lotion are left in.

B. **Passing the Staff.** This step, however simple and easy usually, presents occasional difficulties, the more trying because perhaps unlooked for ; they are :

(1) Spasm, from the urethra not being used to instruments ; (2) stricture ; (3) a false passage ; (4) an enlarged prostate ; (5) an enlarged prostatic sinus, into which the end of the sound passes. Mr. Buchston Browne's staff meets the last two admirably.

C. **Finding the Stone with Sound or Staff. Possible Difficulties.** (1) The stone may have been passed.[3] This is not impossible in children

[1] *Ind. Med. Rec.*, August 1, 1897.
[2] *Med.-Chir. Trans.*, vol. lxix, p. 342.
[3] *Cf.* the case mentioned by Mr. Holmes, *Clin. Soc. Trans.*, vol. ii, p. 67.

with small, smooth, narrow calculi, and their sudden, strenuous micturition. (2) The stone may lie behind an enlarged prostate. Here the finger of an assistant passed into the rectum may help. (3) The stone may be enveloped in folds of mucous membrane. Injection of the bladder is here indicated. (4) The stone may be encysted. This is so rare as to have been called "The refuge of young lithotomists." The following case of Sir G. Humphry[1] shows well how embarrassing this condition may be :

A man, aged 51, was cut, then submitted twice to lithotrity, then again cut in the old scar three times, all within six years, for an encysted calculus. On the fourth occasion of lateral lithotomy the nature of the case was made out accurately. The stone was now felt behind the prostate attached to the bladder by a pedicle which seemed to penetrate the coats of the viscus, and to be attached to another mass beyond it. It was evidently a stone of hour-glass shape, part being in the bladder and part in the sac. At each of the previous operations the part within the bladder had broken off, the rest not being extracted, owing to the size of the prostate. The symptoms recurring, urethro-rectal lithotomy was performed. The stone being now within reach, the edge of the mucous membrane around it was incised with a

Staff

Tuber ischii
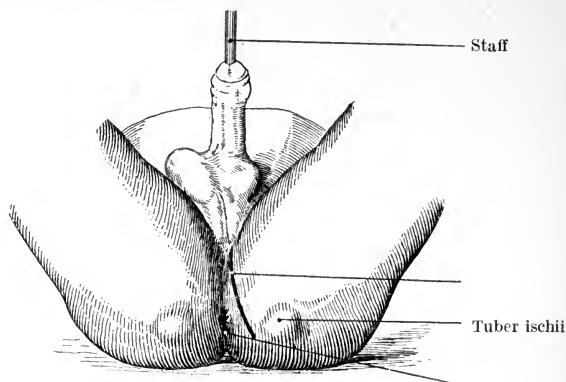
Fig. 270. Lateral lithotomy.

hernia knife, and a stone the size of a walnut, and with a truncated stalk, extracted. Death took place in two days, from pelvic cllulitis. Though the bladder was otherwise but little diseased, the cyst seemed to have originated from the protrusion of mucous membrane between the muscular fibres, as another one existed, though without a stone. The cyst communicated by a considerable opening with the foul, infiltrated tissues. Sir George points out that these cysts may be quite out of reach in lateral lithotomy. As their walls consist only of cellular tissue, mucous membrane, and perhaps a thin layer of muscular fibre, they are easily lacerated during an operation, an accident almost certain to be fatal. The diagnosis is usually to be made by cystoscopy, and the suprapubic operation is indicated here. *See* footnote, p. 659.

D. **Entering the Bladder.** The time chosen for introducing the staff varies with different operators. Passing the staff while the patient is still recumbent is the easier ; passing it when the patient is in lithotomy position is rather more difficult, but secures the operator against the risk of the staff slipping out after the patient is brought down into position, a risk which is greater with the straight staff. I prefer to bring the patient's lower limbs over the edge of the table, to pass the straight staff while he is recumbent, and then to have his limbs only brought up into position.

The nates just projecting over the edge of the table, the sacrum being flat upon it, the flexed thighs and legs being held well out of the way,

[1] *Some Cases of Operation*, pamphlet, 1856.

the surgeon seated comfortably, and with his face on a level with the perineum, directs an assistant so to hold the staff as to bring the membranous urethra close to the surface of the perineum. If a curved staff be used, this is easily done by inclining the handle strongly towards the abdomen. By this manœuvre, in Mr. Cadge's words,[1] the point of the staff " need not, and should not, be withdrawn from the bladder, but if it were it would be of no moment, because it would re-enter it the moment the handle is raised ; the membranous urethra, instead of being almost perpendicular to the surface of the perineum, as it is when the staff is held upright, is brought almost parallel with it, and is much easier to find with the knife ; there is no inducement to open the urethra too far forwards, and consequently no risk of wounding the bulb or its artery. The staff gets a steady rest against the front of the pubes, and there is no danger to the rectum at this stage." It thus combines the advantages of the two very different methods usually given, viz. either to hold the
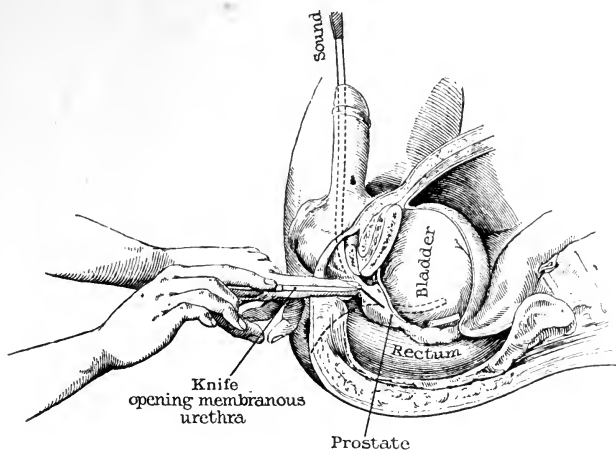
FIG. 271. Lateral lithotomy with a straight staff.

staff well up firmly under the pubes and thus away from the bowel, but also away from the stone, or closely down upon the latter and in proximity to the rectum also.

Having felt the staff thus presented towards him, having examined into the depth of the ischio-rectal fossa, the site of the tuber and ramus ischii, the surgeon, pressing up the junction of the scrotum and raphé so as to make tense the parts just about to be cut, enters his knife from a quarter of an inch to one inch and a half from the anus, just to the left of the raphé, and very likely hits the groove at once. The knife is then drawn outwards and backwards with a rapid sawing movement to a point midway between the anus and tuber ischii, thus making an incision of two or three inches, according to the age of the patient and size of the stone. Again inserting the knife into the upper angle of the wound, the surgeon makes out exactly with his left index finger the groove in the staff, and exposes this, beyond doubt, in the wound. The next step differs somewhat accordingly as the curved or straight staff is used ; they will be given separately.

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[1] *Loc. supra cit.*

(*a*) **With the Curved Staff.** When the knife's point is felt firmly lodged in the groove, its handle is a little depressed; the blade, at the same time, turned a little to the left, is pushed steadily along the groove till a gush of urine or a sense of resistance ceasing, or both together usually, announce that the neck of the bladder has been sufficiently divided with the knife. The finger is now wormed into the bladder over the concavity of the staff.

(*b*) **With the Straight Staff.** When the point of the knife is felt to be safely lodged in the groove, the surgeon takes the handle of the straight staff from his assistant, brings it down, and still keeping his knife in the groove, lateralises the staff slightly to the left. The handle of the knife being now depressed so as to form a sufficient angle with it, and make an adequate wound, the surgeon runs it along the groove steadily, till he knows by the above-given evidence that the neck of the bladder has been sufficiently cut.

The left index finger is next wormed over the edge of the staff, the straight staff being held by the surgeon himself in his right hand, the curved one being held by an assistant, till he feels that he has entered the bladder and placed the finger tip, if possible, in contact with the stone. Entrance into the bladder is known by feeling the finger surrounded with a smooth cavity lined with mucous membrane, while the finger itself is girt by a fibrous ring. The stone being felt, or the bladder cavity distinctly gained, the staff is withdrawn, and the surgeon, while taking his lithotomy forceps, dilates the opening into the bladder with his finger, which, at the same time, pulls down and steadies the neck.

Failure to enter the Bladder. This most vexatious and embarrassing difficulty is most likely to be met with under two widely different conditions: (1) most frequently in little children; (2) in old patients with a very fat, deep perineum and enlarged prostate. The first must be considered separately.

(1) *In Little Children.* The causes here are the small size, delicacy, and mobility of the neck of the bladder and urethra, and the fact that the bladder lies high up above the pelvis. Mr. Cadge quotes the following from Sir W. Fergusson:

" The point of the finger was, as usual, placed on the staff and pushed gently towards the bladder. The finger went on, but I was aware that it had not got between the urethra and the staff. With an insinuating movement (much to be appreciated by the lithotomist who, as I do, professedly makes a small incision in this locality), I endeavoured to get its point, as usual into the urethra and neck of the bladder. But here I felt convinced that I had failed, and was aware that the finger was getting deeper as regards the depth of the perineum, but that I was not materially nearer the bladder. I could feel a considerable space at the point of the finger, and was convinced that the upper part of the membranous urethra, as well as the sides, had given way to the pressure, and that now, as the finger was getting deeper into the wound, I was only pushing the prostrate and neck of the bladder inwards and upwards. These parts seemed to recede before the smallest imaginable force, whilst I felt that I could, in a manner, make any amount of space around the bare part of the staff. I had no difficulty in distinguishing between the surface of this space and that of the mucous membrane of the bladder. Moreover, I knew that I had never crossed that narrow neck which is always felt as the finger passes into the bladder when a limited incision is made. An impression came over me that I was about to fail in getting into the bladder, and I had an idea that, unless I could open up the urethra in front of the prostate more freely, I should probably never reach the stone. This I effected with great caution, and then I could appreciate the passage of the finger as usual through the neck of the bladder. The stone was easily touched and removed, but I was forcibly impressed with the idea that I had

nearly failed in the performance of the operation." The child here was four years old.

Mr. Cadge thus met the same difficulty in an infant of one year and a half :

"I felt the impossibility, even with a fair incision, of distending the wound with my finger ; it was like trying to get into the orifice of the urethra. I therefore desisted before doing any harm, and, taking a pair of common dressing-forceps, I passed them easily along the staff into the bladder ; by opening the blades gently but firmly, room was gained and the finger entered and made room for small lithotomy forceps. But I have repeatedly, after passing the dressing-forceps, withdrawn the staff and removed the stone with them, and without introducing the finger at all."

Difficulties and Mistakes during this Stage of entering the Bladder. This is so important a part of the operation that the following may be enumerated here : (1) Finding the staff. This is not likely to present difficulties in the case of a curved staff if it be held as advised at p. 655. Hitting a straight staff in a fat child is not always easy, owing to the small size which is needful. Attention must be paid to entering the knife at the root of the scrotum only just to the left of the raphé, when the finger-nail will detect the staff at once. (2) Not exposing the staff. Everything which lies over the staff in the upper angle of the wound must be clean-cut. The tissues here, including the membranous urethra, are lax and delicate, and, unless the knife is clearly in contact with metal, the groove will not be followed. (3) Losing the groove. This most serious accident may be due to not getting the knife cleanly into the groove, not keeping it sufficiently firmly in contact with it, and, thirdly, by forgetting to depress slightly the handle of the knife. (4) Cutting the prostate too freely as the knife is brought out. This can easily be avoided by keeping the knife sufficiently near to the staff. (5) Cutting into the rectum. This may be due to neglect of the following precautions : (i) keeping the staff up away from the bowel ; (ii) guarding the bowel with the left forefinger in the wound ; (iii) when the knife is lateralised, cutting away from the gut. Mr. Cadge [1] points out that the usual place of puncture is the dilated part just above the internal sphincter, and that this communication may be made secondarily by sloughing after extraction of a large stone, or after the use of a plug for arresting hæmorrhage. His experience is that "nature seldom fails to bring about a cure, or so to contract the wound as to leave but trifling inconvenience." (6) Wounding the posterior wall of bladder.

Sir S. Wells, at the discussion of Sir H. Thompson's paper,[2] mentioned a case in which Mr. Tyrrell wounded the back of the bladder, and hence always advocated a short knife. That this accident happened even in the hands of Aston Key himself I know through the father of an old Guy's man who was present at the time.

E. **Finding and Extracting the Stone.** The surgeon's left index finger having passed into the bladder along the concavity of the staff,[3] finds the stone, hooks this down as near to the neck as possible, and at the same time steadies the neck while it dilates the incision in it and in the prostate. This combination of movements requires most careful attention to each of its details separately. The most important of these is the dilatation of the neck and prostate. If the stone is found

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[1] *Loc. supra cit.*   [2] *Med.-Chir. Soc.*, April 2, 1878.
[3] This is only withdrawn when the stone is felt, not before.

to be a large one, the deep part of the wound must be sufficiently free. It is well known how much has been written on this matter. The surgeon should begin by dilating the neck of the bladder carefully and equally in every direction, using a considerable amount of force in an adult, but not throwing this on any limited portion of the wound. It may be accepted as a certain fact that the wound in the prostate may extend through the whole of this body, without risk of cellulitis, if only the recto-vesical sheath is not torn through. As long as the finger is girt by a fibrous ring this mischief has not been done. Whether an extensive wound in the prostate had better be made by dilatation and laceration or by free incision will probably never be settled. The wise surgeon will avail himself of a safe use of both—that is to say, after dilating with forcible but equal pressure all around the original wound in the neck, he will introduce a blunt-pointed narrow-bladed bistoury flat against the pulp of his finger, and nick the remaining constriction at one or two places, then dilating again.

Next, as to the size of the stone, the age of the patient must here be considered. After middle life the cellular tissue around the neck of the bladder is not only loose, but abounds in enlarged veins. Hence the risk of causing not only cellulitis, but septic phlebitis, by dilating an inadequate opening by the tearing, bruising exit of the stone instead of by the finger and knife combined.

The deep opening having been thus made sufficiently free, the surgeon, having selected his forceps, introduces them along the finger (thus further dilating the wound), the latter being withdrawn as the forceps enter. These, held at first in one hand (the thumb in the ring), are fully introduced closed, then opened widely transversely, and, by a quarter-turn of the handles, the lower blade is made to scoop or sweep along the floor of the bladder, which will almost surely catch the stone. If this step fail, it is repeated, and if the stone is still not caught, the surgeon feels again for the stone either with the closed forceps or by again inserting his finger, which will bring down the stone, push off projecting folds of mucous membrane, &c. Differently curved forceps, suprapubic pressure, and a finger in the rectum, may all help now.

The stone being caught, the finger again feels if it is held in its shorter axis; if so, it may at once be extracted, if moderate in size, by steady deliberate traction downwards and outwards. As long as the stone advances all is well; if not, gentle rotation may again start it on its way. In less easy cases Mr. Cadge's words should be remembered: "Should there be much resistance and no sense of gradual yielding, the surgeon will ask himself whether this is due to an insufficient opening, or to the projection of the ends of an oval stone laterally beyond the bladder. This latter may be known by observing that the bladder is brought bodily down, so that the prostate, which is probably large, is visible near the external wound; in this case the stone must be liberated, the finger again introduced, and a fresh hold taken. If the obstruction is due to a large stone and too small a wound, the latter is to be enlarged in the direction of the first incision; this, in the opinion of the writer, is preferable to making the division of the neck of the bladder on the opposite side, and preferable, too, to using undue traction and force."

In some cases a scoop will facilitate extraction, the stone being firmly held between the pulp of the left index finger and the concavity of the

scoop. In children one finger in the rectum and one in the bladder will often serve the purpose.

The stone being out, the bladder is carefully explored with the finger, or a short-beaked staff, aided by pressure above the pubes, or from within the bowel, for any other calculi or fragments. Multiple calculi will have been indicated by facets upon the first.

Any bleeding vessels are now secured, a tube introduced, sewn to the skin, dressings applied, and the patient removed to bed. The tube is removed on the third day. In children a tube is avoided.

Difficulties during the Stage of Extraction of the Stone. (1) The position of the stone. This may be out of reach owing to its being at the posterior part of a dilated bladder, above the pubes, or to the patient having a very fat and deep perineum. Pressure above the pubes and the use of long forceps are here indicated. (2) An enlarged prostate. This interferes with reaching the stone both with fingers and forceps. Curved forceps passed in along the staff, or a gorget, if the perineum be very deep, will be helpful here. An enlarged middle lobe of the prostate, or a separate adenoma of this gland, may also cause trouble by getting between the blades of the forceps. Tearing away these portions of the gland has often occurred, and has sometimes certainly been beneficial. When the prostate is known to be considerably enlarged, it is far better to adopt the suprapubic route, for this gives better access, and allows the surgeon to examine the bladder thoroughly, so that he may not overlook a stone behind the prostate or an encysted one (p. 640). In suitable cases, with but little cystitis, the prostate may be enucleated immediately after the removal of the stones. In others, with much cystitis, or interference with the renal function, it is better to be content with lithotomy only at first, and to remove the prostate at a secondary operation, when the cystitis and the excretion of urea have improved as a result of drainage, &c. The mere removal of the stone is not enough, for the obstruction due to the enlargement of the prostate is usually the cause of the calculous formation. Perineal prostatectomy is not so satisfactory as the suprapubic operation when a stone is present, although small calculi can be extracted after removing the prostate through the perineum. (3) Breaking up of the stone. This may occur with hard calculi from too much force being used with the forceps, but it much more often happens with soft phosphatic calculi. In such cases every fragment must be cleared out—a matter of some difficulty, as small ones are readily concealed in clots or folds of mucous membrane. After all the larger ones are picked out a catheter of appropriate size, attached to a Higgenson's syringe, is inserted, and the bladder thoroughly washed out with boracic lotion. In a week or ten days the bladder should again be carefully sounded, and examined with the finger, and any fragment extracted, this being especially needful if pain has persisted after the operation.[1] If fragments still persist a little later, an evacuating-tube and washing-bottle, aided if necessary by a flat-bladed lithotrite, must be employed. I may here express my belief that multiple calculi are not quite as rare as has been supposed. (4) Size and shape of the stone. Mr. Erichsen writes on

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[1] Recurrence of stone within two years almost always means that a fragment has been left after the operation. No greater disappointment than this, both to the surgeon and patient, can happen. No one, probably, has cut fifty patients without having to admit and lament its occurrence, but it is especially liable to occur to the inexperienced (Cadge).

this subject : " A calculus, about an inch and a half in its shorter diameter, will be hard to extract through an incision of the ordinary length (not exceeding eight lines) in the prostate, even though this be considerably dilated by the pressure of the fingers ; and I think it may be safely said that a calculus two inches and upwards in diameter can scarcely be removed by the ordinary lateral operation with any degree of force that it is safe to employ." Most will agree with Mr. Cadge that stones weighing upwards of 3 oz. will be dealt with by the improved suprapubic method. Mr. Jacobson performed this operation twenty-six times, with only one death, which occurred in an aged very emaciated man with advanced kidney disease. The patient was in great suffering, and death would have been probable after any operation. Mr. Jacobson regards lateral lithotomy as a very safe operation (*see* p. 648, footnote), and still advocates it for children, and writes : " I do not believe in the frequency of after-sterilisation, of which a few cases used to be reported from time to time. If this be a *causa vera*, I believe the risk to be less than that of the suprapubic operation in ordinary hands." Freyer had only one death in 200 male children.

SUPRAPUBIC LITHOTOMY (Figs. 252, 253)

Indications. The surgeon who has the opportunity of becoming an adept in the use of the lithotrite, will seldom have occasion to perform suprapubic lithotomy. Where, however, there has been no such opportunity, this operation will be required for the following conditions. These I quote from the concluding portion of a paper read by Mr. Jacobson some years ago before the Royal Medico-Chirurgical Society.[1]

(1) " That suprapubic lithotomy has a future of renewed usefulness before it, and that while, as an operation, it can never contrast with the rapid brilliancy of the lateral operation, it will be found of great value by those who only have to deal with stone occasionally, and by those who find themselves face to face with calculi of considerable size in adults. (2) That, to give other and more individual instances, the operation will be found useful (*a*) in many cases of hard stones of an inch and a half in diameter ; (*b*) in multiple hard stones ; (*c*) in some cases of foreign body in the bladder with abundant calculous deposit (Sir H. Thompson) ; (*d*) in cases of encysted stone.[2] (*e*) In the rarer cases of a state of urethra which will not admit the use of a lithotrite or a grooved staff. . . ." To these should be added, (*f*) in cases where the stone is associated with enlarged prostate (p. 638). The suprapubic opening will here be convenient for removing the prostate as well as the stone, and also for thoroughly examining the interior of the bladder and removing all the calculi with certainty. The calculus is generally secondary to the prostatic enlargement, so that it is necessary to remove the prostate to give complete and permanent relief. The prostate may be enucleated either at the same sitting or later if there is much cystitis, or the renal excretion is seriously lessened. Free drainage and the removal of the stone may be followed by great improvement, and a secondary prostatectomy then undertaken successfully. (*g*) In cases of sacculation of the bladder, or where

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[1] *Trans.*, vol. lxix, p. 377.

[2] Much useful information may be gathered from a paper by Mr. Bruce Clarke (*Brit. Med. Journ.*, May 13, 1899), in which an account is given of 27 cases of encysted vesical calculus.

a stone has been seen through the cystoscope to be impacted at the ureteral orifice with a projection into the bladder.

Preparations. Cystitis must be treated as far as possible by rest and by irrigation of the bladder for some days before the operation, and by the administration of such urinary antiseptics as urotropine, helmitol, boracic acid, benzoate of ammonium, &c. Urinary excretion may be promoted by copious libations and by diuretics. The bowels should be kept well open, and the rectum thoroughly washed out on the morning of the operation. The bladder is washed out, distended and opened as already described under suprapubic cystotomy (p. 604). A small incision is made into the bladder and the left index finger is at once introduced to feel for the stone. The finger at the same time keeps the bladder hooked up, and prevents it settling back into the pelvis as it empties. The stone is best removed by two fingers, or, if preferred, by forceps or scoop. The fingers, if successful, have the advantage of not risking any injury to the mucous membrane. Removal of the stone is not always easy ; it falls back into the fundus, or into a retro-prostatic pouch out of reach. An assistant's two fingers passed into the rectum may be of service in pushing the stone forwards. Care must be taken not to bruise or lacerate the edges of the vesical incision or to break the stone into pieces by attempting to remove it through an aperture which is too small ; it is far preferable to enlarge the latter by stretching with two fingers without delay. More room can thus be obtained without increasing the bleeding from the wall of the bladder. All debris must be carefully removed with the scoop and by irrigation.

Great difficulty may be met with in removing an encysted calculus, owing to the fact that the stone usually entirely fills the sac, the neck of which is frequently quite narrow. If the neck cannot be sufficiently dilated to deliver the stone, the latter may be broken up with suitable forceps and removed in pieces.

When the sac is low down or lateral, the lower margin of its neck may be safely incised, without risk of opening the peritoneum. A stone impacted at the lower end of the ureter may if necessary be released by incising the mucous membrane over it in a direction parallel with the course of the ureter. In some cases when no stone is found in the bladder one will be discovered in the prostatic urethra on passing the index finger into this. The stone is easily dislodged and removed. Occasionally a stone forms in the cavity left after prostatectomy. This is usually large, rough, firmly impacted and very difficult to remove until the neck of the bladder is incised over the calculus in the middle line behind.

The question now arises of closing the opening with sutures or leaving it open, in part at least.

When there is little or no cystitis or bleeding, and the renal function is good, the bladder is closed. One of the first to adopt this plan success-fully was Dr. L. S. Pilcher of New York ; a catheter was used till the ninth day, the patient, an adult, went out on the fourth, and on the four-teenth day was shown to the New York Medical Society, primary union having taken place throughout the whole extent of the wound, without unpleasant symptoms of any kind. Mr. R. W. Parker had an equally successful case in a child aged 3, and since then similar cases have become quite common, but occasionally some urine leaks any time from the third to the ninth day. Hence the importance of leaving a small

tube at the lower angle of the parietal wound for three or four days to prevent the possibility of extravasation of urine. The drain should not lie in contact with the bladder, but only just reach the prevesical space. A continuous Connell suture of catgut put in efficiently suffices, and prevents bleeding into the bladder from the wound in its anterior wall. The first suture may be reinforced by a second one in some cases, especially if there has been any bruising of the edges. When the bladder is sutured great care must be devoted to securing and maintaining efficient drainage through the catheter, for if the bladder is allowed to get distended, pelvic extravasation is almost certain to occur. A large-sized and large-eyed soft catheter is inserted before the bladder is closed, and its eye should be just above the vesical orifice. It is carefully secured so that it may not slip either in or out, and the rubber tubing attached to it has its other end immersed in antiseptic lotion in a vessel attached to the side of the bed. The whole drainage apparatus must be air-tight to be efficient. If the eye of the catheter gets blocked with clot, this must be displaced at once, by running in some boracic lotion. Some vigorous patients, after accurate suturing, do not require a catheter, but prevent distension by micturating every two or three hours during the first few days. Bergmann drains through a median perineal puncture, which is made by cutting upon the points of forceps, passed from the bladder through the urethra. This method may be adopted in selected cases in order to avoid suprapubic drainage.

Sutures should not be employed (1) where there is cystitis, and the urine ammoniacal or the kidneys diseased and the renal excretion poor; (2) where the bladder is irritable, thickened, and the better for drainage; (3) where the extraction is difficult and prolonged, and the parts necessarily bruised; (4) where there is any reason to expect bleeding : in such cases the clots will cause violent tenesmus, and, probably, giving way of the sutures; (5) where there is any stricture or an irritable condition of the urethra sutures are inadmissible.

Where drainage is adopted the vesical wound is diminished if necessary with inverting sutures, until it grasps the large rubber tube inserted. A wick of gauze below the tube in the prevesical space guards against dangers of any possible leakage.

Two or three buried catgut sutures then draw the muscle fibres and aponeurosis together above, while three or four more unite the skin, or salmon-gut sutures alone may be used, some of them being passed deeply so that they approximate the muscles; buried sutures are thus avoided.

The bladder is drained and the wound dressed as already described (p. 605).

Southam [1] records a death-rate of nearly 24 per cent. for 46 suprapubic lithotomies. This mortality seems to be unusually high; " it must be remembered, however, that the cases so treated were all unsuited for lithotrity, the latter operation being contra-indicated in each instance—with one exception—on account of the large size of the stone, associated either with enlargement of the prostate, and an unhealthy state of the bladder and urine, or with a feeble condition of the patient, in consequence of which the shock of a prolonged crushing operation would not have been well borne. The fatal result in these cases was due in several instances, when the patients were advanced in years, to sudden heart failure,

[1] *Brit. Med. Journ.*, 1904, p. 1190.

coming on at some interval after the operation, when all was apparently progressing favourably ; in others, as proved by necropsy, it was the result of pre-existing secondary renal disease, death being preceded by suppression of urine and other evidences of uræmia."

"Barling collected 72 cases of suprapubic cystotomy performed in London and provincial hospitals between 1888 and 1892, the patients all being under 20 years of age, and in 15 instances there was a fatal result, giving a mortality of 20 per cent." Recent improvements in technique and especially in drainage have reduced the mortality much below this figure. Thus Freyer [1] in 149 suprapubic lithotomies in adults had a mortality of only 12·75 per cent., although prostatectomy was performed at the same time in 110 of these cases.

While on some points connected with the operation my mind remains open, I am strongly of opinion that, with care, it is easier and safer than the lateral method for those who only perform lithotomy occasionally, and for large stones, *e.g.* over 1 oz.

MEDIAN PERINEAL LITHOTOMY

Disadvantages. (1) It gives very little room, and is unsuited to any save the smallest stones. (2) The wound being small, the surgeon cannot bury his knuckles in it, or reach the bladder as easily as in the case of the larger lateral wound. Only the base of the bladder can be explored, so that a stone in a pouch may be overlooked. (3) The rectum on the one hand, and the bulb on the other, are in greater danger than by the lateral method. (4) Troublesome bleeding is more frequent.

Mr. Cadge, having operated on 50 or 60 cases by the median method, gave it up for the above reasons, and also because his mortality was rather higher. For these reasons the suprapubic operation has almost entirely replaced it for large stones, for small stones litholapaxy is much better.

Advantages. Recovery is often extremely rapid ; the urine quickly resumes its natural route ; and the wound, instead of gaping and healing slowly as the lateral wound does, heals almost by first intention.[2] It inflicts a minimum of damage ; for these reasons Mr. Jacobson considers the operation to be the most suitable for elderly men with comparatively small stones where litholapaxy is impracticable. In most cases of stone in old men enlargement of the prostate with partial retention is the cause of stone formation, and then the crushing or removal of the stone affords but temporary relief. Therefore, suprapubic exploration with removal of the stone and if necessary enucleation of the prostate is indicated. Preliminary cystoscopy may reveal the enlargement of the prostate.

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[1] Burghard's *System of Surgery*, vol. iii, p. 518.
[2] Dr. W. T. Briggs, of Nashville (*Trans. Amer. Surg. Assoc.*, vol. v, p. 127), thus sums up the advantages of median lithotomy : (1) It opens up the shortest and most direct route to the bladder. (2) It divides parts of the least importance. (3) It is an almost bloodless operation. (4) It affords a passage for any calculus which can be safely extracted through the perineum. (5) It affords the best passage for the fragmentation of unusually large calculi. (6) It reduces the death-rate to a minimum. In answer to the objection to the median operation that it is unfitted for the extraction of large stones, Dr. Briggs states that by making it a medio-bilateral operation (*vide infra*), as large stones can be removed by it as can be extracted by the lateral method. Since adopting the above modification, Dr. Briggs has had the following excellent results : Of the first 74, none died. Then two died, but one of these had a pelvic abscess before the operation, and the other died at the end of three months with phthisis, and the wound unhealed. Since then Dr. Briggs has had 46 cases with one death.

Perineal lithotomy is unsuitable especially when the stone is partly or completely in the prostatic urethra, whence it cannot be dislodged for crushing ; for children, for whom it is by some preferred, as in them a free incision is necessary to facilitate the passing of the finger into the bladder, while here the limit of space for the knife is very small indeed.

Operation. The patient is carefully prepared so that the rectum is empty and not likely to act during the operation. He is placed in the lithotomy position, and a curved staff with a wide groove along its convexity is passed and then held by an assistant so that its handle is inclined towards the umbilicus and its convexity is pushed downwards towards the perineum. The assistant also holds the scrotum forwards out of the way. The surgeon sits facing the perineum and makes a median incision two inches long with its posterior extremity at least half an inch in front of the anus, so that the bowel and its sphincters are not damaged. As the incision is deepened the point of meeting of the perineal muscles and the sphincter ani is seen, and a transverse incision is made separating the external sphincter from the ejaculator urinæ. The bulb is drawn forwards, and the membranous urethra made prominent by means of the staff is seen and felt. The left forefinger, feeling the groove, on the staff guides a long narrow-bladed knife to open the urethra, and the knife, with its edge backwards, is pushed on along the groove until it reaches the prostatic urethra. The knife is withdrawn and a conical probe-pointed director with a wide groove is run along the groove on the staff until it reaches the bladder as shown by a rush of urine. The left forefinger is passed along the director into the bladder to explore the base, but in spite of suprapubic pressure only a limited exploration is possible, and it is difficult to insert the finger through the narrow and deep neck of the bladder. If the finger cannot be introduced into the bladder, forceps of different sizes may be passed and used to dilate the passage. A small stone is removed with a scoop or long-handled lithotomy forceps. If the stone is too large to be extracted in this way, a slight bilateral cut is made in the neck of the bladder, care being taken not to destroy the sphincter. A rubber tube is inserted into the bladder, sewn to the perineal skin, and left in for two days.

Director.

Fig. 272.　Median lithotomy. The left forefinger being introduced along the director, which was passed into the bladder before the withdrawal of the staff.

OPERATION FOR TUBERCULOUS CYSTITIS AND FOR CHRONIC OR CALLOUS ULCER OF THE BLADDER. OPERATIONS FOR DIVERTICULA OF THE BLADDER

TUBERCULOUS CYSTITIS

TUBERCULOUS disease of the bladder is nearly always secondary to similar disease of one kidney. Cystoscopic examination often shows cystitis limited to the neighbourhood of the corresponding ureteral orifice, which may be dilated, ulcerated, retracted, or discharging pus or debris. Little or no indigo-carmine may escape from that ureter while it issues very freely from the opposite one. Catheterisation of the ureters with bacteriological examination of the separated urines may prove the disease to be unilateral. Later both the kidneys may be affected, and occasionally both kidneys are diseased from the beginning. Often the epididymis, especially on the corresponding side, is tuberculous, and the vesiculæ seminalis, ejaculatory duct and the prostate are similarly affected. Often the disease is primary in the lungs, lymphatic glands, bones or joints. Therefore, operations on the bladder are usually mis-directed ; the infecting and irritating kidney or testes should be removed without delay, and the bladder heals, as a rule, without any interference. Occasionally cystitis persists after nephrectomy owing to the incomplete removal of a tuberculous ureter. In such a case excision of the ureter completely cured a patient who used to micturate every few minutes day and night. The patient was well ten years later.

Occasionally, however, *one or more definite localised tuberculous ulcers* may form in the bladder. Sometimes this condition is found after the removal of a tuberculous kidney. Such a localised chronic ulcer calls for excision, and this is best carried out by suprapubic cystotomy, but it is of the greatest importance to exclude tuberculous disease of the kidney or incompletely removed ureter, before deciding to open the bladder. The ulcer is usually at the base near one of the ureters, and is not easy to excise. A large ulcer may be scraped and cauterised (Battle [1]).

Apart from localised chronic ulcer cystotomy is very rarely justifiable, and in any case is only to be considered after the removal of the infecting kidney.

Even in the rare cases when tuberculous cystitis is primary, it is an accepted fact that in tubercular affections in which it is not possible to remove the mischief operative interference may do more harm than good. Under such conditions the manipulations only irritate early tubercle into activity, and light up again obsolete or quiescent tubercle,

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[1] *Clin. Soc, Trans.*, vol. xxiii, p. 20.

besides causing certain dangers [1] peculiar to this viscus, viz. cystitis and pyelitis. Again, to show how useless and even harmful will be operative interference in the early stage of tubercular mischief, a stage in which alone can such treatment be expected to be curative, let us consider what are the conditions present at this early stage. To put it briefly, it is not one suitable for curetting, &c., as is often the case with tubercular mischief elsewhere.[2] The mucous membrane is swollen, very vascular, velvety, at times gelatinous. Any ulcers present are often small, even minute and numerous, so that it is impossible to make sure of efficient curetting, especially when any one familiar with the interior of the bladder knows how quickly a little bleeding hides the field of operation, and the fact that the mischief is usually most marked on the posterior wall, trigone, and neck. The following is a good description of a condition often present in these cases [3] : " The trigone and a band of about an inch in depth around the urethral orifice were the seat of many superficial ulcers, varying in size from that of a split pea to irregular patches as large as a five-cent piece. The mucous membrane of the whole fundus of the bladder was also studded with small tubercles which had not advanced to the stage of ulceration nor, indeed, even to the length of showing signs of caseation. The ulcerated patches were scraped and cauterised, but the little non-ulcerated tubercles were left untouched. They were so numerous that it would have been impossible to deal with each one singly."

If tuberculous cystitis persists after the removal of the infecting kidney, it should be treated, not by operation,[4] but by improving the hygienic surroundings, especially, whenever it is possible, getting the patient to be much in the open air, if possible by the sea. Tuberculin is of some value in suitable cases, although it is not claimed that a cure may be obtained from its use. It should not be resorted to unless the disease is limited to the bladder, and after the tubercle bacilli have been found in the urine. It relieves the pain, diminishes the frequency of micturition and the hæmorrhage. In some patients, however, the symptoms have been aggravated by the injections (Fenwick, Wright, and others [5]). This method is certainly worthy of a thorough trial with the precautions and restrictions mentioned. Intravesical injections of iodoform emulsion, solutions of bicyanide of mercury, chloride of zinc, or nitrate of silver, are disappointing, painful and troublesome, and although they sometimes relieve symptoms they may aggravate the disease. Internal administration of urinary antiseptics, such as urotropine, helmitol, and others is

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[1] Another ill result which is very possible here is rupture by even a moderately distending injection of a contracted, rigid bladder the seat of long-standing tubercular mischief, and one emptied for some time by irritability and incontinence. I would refer my readers to two such cases candidly published by Mr. H. Fenwick in his instructive book *Cardinal Symptoms of Urinary Diseases*, p. 200.

[2] Prof. Guyon reported (*Ann. des Malad. des Voies Urin.*, November 1889) very fully four cases which he treated by curetting and the cautery after a suprapubic cystotomy. One of the four died two years after the operation, the patient having a persistent sinus and being bedridden most of the time. One died within the year, and one within about three months of the operation. The fourth had survived four years.

[3] J. Bell, M.D., of Montreal, " Treatment of Tuberculosis of the Bladder by Suprapubic Section," *Journ. Cutan. and Genit. Urin. Dis.*, 1892, p. 298.

[4] Dr. L. Bolton Bangs, of New York, whose experience in diseases of the genitourinary organs is a very wide one, thus expresses himself on this matter : " After faithful and zealous efforts to relieve by surgical interference the local symptoms of these cases, I have been forced to the conclusion that the less instrumentation we resort to the better."

[5] *Lancet*, 1904, vol. i, p. 935.

often useless. The cases that call for operative interference are those in which what I may be allowed to call hygienic treatment has failed, or in which the case has got beyond this, where pain is incessant, micturition frequent, *e.g.* every half-hour, day and night, with much tenesmus, and where opiates are required to afford sleep. If both kidneys are tuberculous, or one has already been removed, *suprapubic cystotomy* may be performed for the relief of symptoms. In women a self-retaining catheter is easily introduced and if tolerated avoids the need of a suprapubic cystotomy.

The suprapubic operation is always to be preferred. The perineal gives very little room, and, moreover, has the great drawback that a tube thus introduced will very likely press upon the neck or base, parts very liable to be attacked by tubercle. Again, this opening has a great tendency to close before the full benefit of drainage has been secured. Too often the after-treatment of suprapubic cystotomy for tubercular cystitis resolves itself into the following dilemma. If the opening is closed all the pain, &c., soon recurs ; if it is kept open there is much difficulty in preventing noisome soaking. A tube worn in the suprapubic sinus rarely acts well in these cases, where the bladder is often small, contracted, and thick-walled.

Transplantation of the trigone or ureters into the rectum is not to be recommended, for apart from their immediate danger, in these cases ascending nephritis is almost certain to develop sooner or later.

Cystectomy is far too dangerous an operation. Moreover, cutaneous ureterostomy without cystectomy relieves the symptoms. Vaginal ureterostomy may be performed in women.

Operation. The details of a suprapubic cystotomy are so fully given at pp. 602 to 606, that it is needless to repeat them here. I will only add the caution that great care must be taken in distending these bladders. Four to six ounces will be as much as can usually be injected with safety. The bladder is first opened, and its interior exposed with some suitable retractor (p. 614), aided, if needful, by the Trendelenberg position (Fig. 256, p. 614). A single ulcer may be excised in some cases, and bleeding is arrested with the cautery. Any ulcers should be carefully and thoroughly curetted or cauterised with a fine point of the Paquelin thermo-cautery. To any very vascular, gelatinous-looking mucous membrane, not ulcerated, a solution of $AgNO$ gr. xxx—$\mathrecal{3}$j should be applied on a small sponge on a holder.

The following is a good instance of the relief which suprapubic cystotomy may give in a very obscure case :

In May 1890 I was asked by Dr. Cock and Dr. Hodgson, of Exmouth, to explore the bladder of a gentleman, aged 57, suffering from painful cystitis, hæmaturia, and frequent micturition, to which general treatment, washing out the bladder and drainage by a catheter, had failed to give any relief. Calculus being excluded by sounding, and there being no rectal enlargement of the prostate, I expected to find a small malignant growth, as the symptoms were too urgent for prostate trouble, and as this gland was not enlarged either to the finger or the sound. The bladder, having been opened and emptied by the suprapubic method, at first appeared normal save for some subacutely inflamed rugæ which stood out very distinctly on the right lateral aspect of the neck of the bladder. A small electric lamp at once showed amongst these folds two ulcers each about one inch by a quarter of an inch, oval in shape, with muscular fibre clearly exposed on their floors, their edges neither thickened nor indurated. They were scraped with a sharp spoon, and iodoform was then rubbed into their surfaces. The patient made an excellent recovery, and now, six years later, remains quite well. In this patient, with a deep, fat perineum, I should never have detected the ulcers by the perineal route.

If the operation is performed with the object of securing long-continued drainage, only a small incision is made into the bladder, and the edges of this are carefully sutured to the skin, so that the fistula may not close so readily.

Hartley [1] has removed the whole bladder for tuberculous disease; he joined the ureters with a part of the bladder to the sigmoid colon. The operation gave great relief, and the patient was well and working as a clerk nine months later. She voided urine about three times during the day and once or twice in the night. Total extirpation can be rarely indicated for tuberculosis, and should not be contemplated until hygienic treatment and injections of tuberculin have been well tried.

CHRONIC OR CALLOUS ULCER OF THE BLADDER

As pointed out by Fenwick,[2] chronic ulcer of the bladder sometimes occurs apart from cystitis, tuberculous, or malignant disease. It is generally solitary, small, rarely more than half an inch in diameter, and situated near a ureteral orifice—often above and internal to this. Its edges are thick and somewhat raised, and its base is often covered with mucus, or later, with phosphatic crusts. It is nearly always found in young men, although a similar ulcer is occasionally found in women who have borne children.

It usually causes slight and sometimes profuse hæmaturia, frequency and great urgency of micturition with much straining. There is severe pain on the under surface of the penis near the peno-scrotal angle. Later cystitis develops and the general health deteriorates. Before cystoscopy, tuberculous disease of the bladder is generally suspected, but no tubercle bacilli can be found on repeated examination of the urine, and microscopic examination of the excised edge of the ulcer reveals signs of chronic inflammation but no tuberculous granulation tissue.

With time the size of the bladder diminishes so that only three or four ounces of urine can be retained. This is probably due to retraction of the muscle wall as a result of chronic reflex spasm.

This form of ulceration often fails to respond to medicinal treatment and local applications such as silver nitrate, the cautery or fulguration. Therefore it is often necessary to excise the ulcer, and it is better to do this early, before retraction of the bladder and deterioration of the general health occur.

Buerger [3] has removed the edges of the ulcer with the operating cystoscope, but it is better to adopt suprapubic cystotomy, which enables the surgeon to perform a more radical operation. The ulcer is excised and the wound sewn up with catgut, just as in the excision of growth of the bladder, except that there is no need to remove such a large margin of healthy tissue. Before opening the bladder great care is taken in excluding tuberculous disease of the kidneys. The following case is a good illustration of this rare condition :

A man, aged 23, came back from Canada to undergo an operation, which had been advised for the following symptoms. In January 1909 he passed a few drops of blood at the end of micturition, and ever since then a little blood follows almost every act of urination, which has been accompanied by much straining. He has

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[1] *Loc. supra cit.*
[2] *Ulceration of the Bladder*, 1900, and *Clinical Cystoscopy*, 1904.
[3] *Med. Record*, April 12, 1913.

passed water from three to six times every night, and every half an hour to an hour during the day. He has lost thirty pounds in weight. He was sent to me with a suggested diagnosis of villous growth of the bladder, or, possibly, tuberculous cystitis. On cystoscoping an ulcer was found above and internal to the left ureteral orifice, and a good deal of cystitis at the base. Both kidneys were excreting well, and no tubercle bacilli were found upon repeated examination of the urine. The bladder held only three to four ounces, even after instillation of cocaine. Even when the patient was deeply anæsthetised for the operation only six ounces could be introduced into the bladder. By suprapubic cystotomy the ulcer was excised. It was a little larger than a shilling, and its upper edge projected downwards as a thick flap. Microscopic examination of this part revealed neither new growth nor tuberculous disease. A good but somewhat slow recovery ensued. It was some months before the capacity of the bladder became normal and micturition natural in frequency. The patient has remained quite well for four years.

OPERATIONS FOR DIVERTICULA OF THE BLADDER

Diverticula of the bladder may be congenital, but they are far more frequently acquired. In any case they are chiefly due to obstruction to the flow of urine from the bladder; the muscular tissue hypertrophies, becomes trabeculated, and pouches, consisting mostly of vesical mucosa, are forced out between the muscle bundles. Sometimes a sacculus is found extending into the lower part of the urachus and is the remains of the Allantois. Occasionally a pouch projects into the peritoneal cavity, but in the great majority of cases these accessory cavities are in the pelvic cellular tissues behind or to the side of the lower part of the bladder, and open often by narrow openings near one of the ureteral orifices, especially the left. Occasionally the ureter opens into the diverticulum, and is more or less obstructed by it. Apart from this, diverticula often press upon the ureter as it courses through the pelvic cellular tissue; and the secondary changes in the kidney, such as hydronephrosis and pyelo-nephritis, are the most serious consequences of these diverticula.

Another serious danger arises from the inability of diverticula to empty themselves by muscular contraction, for there is very little, if any, muscular tissue in their walls, which consist almost entirely of herniated mucosa. Moreover, their openings are usually small and often liable to complete closure during contraction of the bladder, and usually the sacs are ill-placed for drainage. Consequently decomposition of urine with diverticulitis is frequent, and stone formation is not uncommon. Diverticula are far more common in males, who mostly come for treatment before middle age. In old age enlarged prostate is a common cause, but the symptoms are merged in those of enlargement of the prostate.

Symptoms. After urination the patient often feels that he has not emptied his bladder, and upon trying again soon afterwards he may pass several ounces of urine, which is often foul and different from the original. Cystoscopy may reveal the black opening of the cavern, and radiography after injecting a 5 per cent. solution of Collargol into the bladder, may show the accessory cavity and give a fair idea of its size. Lerche [1] passed through the cystoscope into the cavity a rubber bag tied to the end of a fine catheter, and on distending the bag found the latter admitted 200 c.c. of boracic lotion.

Treatment. Diverticula of the bladder sometimes cause no symptoms, for it is not uncommon to discover them after death from other causes, or during cystoscopy or operation for other conditions, such as enlarge-

[1] *Ann. of Surg.*, vol. i, p. 285.

ment of the prostate. In the latter the obstruction overshadows the mechanical result.

When diverticulitis develops and persists in spite of the removal of obstruction of the urethra, the patient is very uncomfortable and is threatened with destruction of one or both kidneys. Therefore it is often necessary to operate. Palliative operations have not been attended with much success; whereas of the fifteen operations by excision of the sac collected by Lerche only one died and the functional results were on the whole good.

Palliative. Simple drainage of the diverticulum into the vagina or on to the skin of the abdomen has been fairly successful, but drainage behind the prostate into the perineum is not to be recommended. Stretching the orifice of the diverticulum is almost useless, for it soon contracts again. Free incision downwards away from the peritoneum was very successful in one of my cases. The patient, who had a stone removed from a large pouch to the left of the bladder, was quite well seven years later. But as a rule the symptoms recur. Suprapubic drainage of the bladder affords only temporary benefit.

Radical Operations. Although sacculi have been successfully removed by the vaginal route, and a partial success has been obtained by adopting the sacral route, it is much better to approach the sac from the front generally without opening the peritoneum.

(1) *The Suprapubic Intraperitoneal Route.* When the sac projects into the peritoneum from the upper and back part of the bladder it is, however, generally necessary to open the peritoneum, and a few successful operations have been carried out in this way, the bladder being well washed out, the abdomen opened, and the peritoneum over the sac incised. The sac is excised, its neck carefully sutured with catgut, and the peritoneum sewn over it, the bladder being temporarily drained with a catheter.

(2) *The Suprapubic Extraperitoneal Route.* This is much the best way of dealing with diverticula of the bladder, which are nearly always subperitoneal and often quite low in the pelvis. Cystitis is treated as far as possible by urinary antiseptics and irrigation. Just before the operation the bladder is carefully washed out and about ten ounces of boracic lotion left in. A median suprapubic incision is made as usual and, if necessary to obtain more room, the rectus on the same side as the sac is partly or completely divided about one inch above the pubes. The bladder is opened and carefully examined, for there may be several sacculi. The left forefinger is passed into the sac, bringing the latter upwards and forwards, while its anterior and external surfaces are exposed by gauze dissection in the lateral pelvic cellular tissues. Lerche in one case introduced into the sac a rubber bag tied on the end of a ureteral catheter, and distended this with boracic lotion. A similar bag may, if necessary, be introduced into the sac through the suprapubic wound, but the finger generally suffices. As the posterior part of the sac is approached care must be taken with the vessels and especially the ureter, which is often adherent to the sac and sometimes discharges into it. When the sac has been completely isolated, its neck is divided and the mucous and muscular tissues around its neck are sewn in layers with interrupted catgut sutures. If the ureter ends in the sac the former is divided close to the sac, and its dilated end is sewn to the upper angle of the postero-lateral gap, which is left in the bladder after the removal of the sac. Two lateral catgut sutures

are generally sufficient. A large tube is placed in the space formerly occupied by the sac and brought out into the suprapubic wound, and the bladder itself is drained suprapubically by a large tube as already described on p. 605. It is rarely wise to close the bladder completely as there is nearly always a good deal of cystitis, and drainage by catheter through the urethra is not satisfactory. In several cases secondary perineal drainage of the bladder had to be adopted. It is better, therefore, to drain the bladder suprapubically from the first and not to submit the sutured neck of the sac to undue pressure. After about four days the tubes are removed and the wound is allowed to heal.

CHAPTER XXXVII

ECTOPIA VESICAE

THE various methods adopted for the relief of this terrible affliction may be divided into three main groups.

(1) The first group consists of plastic operations which aim at the formation of a new anterior vesical wall. Wood's method has been most widely adopted. The anterior wall of the bladder is formed by skin flaps. The advantages gained by the operation, if successful, are that a receptacle for the urine is formed, and that the exposed mucous membrane is covered in and protected ; but unfortunately the most important lower part, where the ureters discharge, pouts and remains exposed to as much irritation as ever. Fistulæ are common even after repeated operations, and then the patient is very little better off than before, because the urine cannot be collected satisfactorily by a urinal. It is important to remember that no sphincter can be provided, and therefore no control, so that a urinal must be worn constantly as before, even in the most successful cases.[1] In these cases the patients can be kept dry during the day, and some of them also at night, but the best urinal is an offence and a danger. In a few cases the urine has been retained for an hour or two, but various mechanical contrivances designed for increasing the retaining power have not been attended with more than temporary success as a rule. Moreover, with the growth of hair into the bladder, cystitis is set up, and the hairs are constantly the seat of phosphatic deposit which will probably have to be removed at intervals.

Attempts have, however, been made to form the new bladder of mucous membrane instead of skin, but stones have formed even when the whole of the new bladder has been lined with mucous membrane either of intestinal or vesical origin.

Tizzoni and Poggi successfully removed the bladder of a dog and replaced it by a new bladder formed from a piece of small intestine, which they left attached to its mesentery after having cut it out of the circuit of the alimentary canal. Rutkowski,[2] acting on this suggestion, successfully made use of an intestinal flap for ectopia in a boy aged 9.

The following account of the operation is given by Warbasse : [3]

" A median incision, six centimetres long, was made, terminating below at the bladder. After opening the abdomen, a coil of ileum was brought out and divided at two points, six centimetres apart. This six centimetres of intestine was isolated. The intestine was united by an end to end anastomosis with two rows of continuous silk suture, and replaced in the abdomen. The excised segment was divided longi-

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[1] In a few cases the new-formed bladder has been capable of retaining the urine for several hours, notably one recorded by Trendelenberg, but the fact remains that no satisfactory living sphincter has been constructed. Stones are most likely to form in the most continent bladders.

[2] *Cent. für Chir.*, No. 16, 1899.   [3] *Ann of Surg.*, August 1899.

tudinally opposite its mesentery, thus forming a quadrilateral flap about forty square centimetres in size, attached to the mesentery along its middle. After detaching the bladder from the abdominal wall and enlarging the bladder opening, the intestinal flap was sutured by two rows of running suture into the defect. The deeper suture of catgut included the entire thickness of the bladder and intestinal walls, with the exception of the mucosa. The outer suture of silk was applied as a Lembert suture. This gave a urinary bladder with an anterior wall formed from intestinal flap receiving its nourishment through its own segment of mesentery. Over the whole the abdominal wall was closed. A catheter was left in the urethra for permanent drainage of the bladder. The operation lasted an hour and a half. The condition of the patient immediately after the operation was excellent. The post-operative course of the case was ideal, entirely afebrile. The wound healed per primam. On the tenth day the sutures were removed. Eight weeks after the operation the patient was able to retain twenty-five cubic centimetres of urine in the bladder. Under pressure this amount could be increased to thirty cubic centimetres."

(2) In the second group of operations no attempt is made either to construct a bladder, or to provide an alternative and controllable receptacle, but the ureters are transplanted into the urethral gutter, so that the urine can be conducted more easily into a urinal. This operation is more successful than the more elaborate flap methods, although it is less ambitious.

(3) In the third group of operations no attempt is made to form a bladder, but the course of the urine is diverted into the bowel, which thus becomes the receptacle for the urine.

A number of surgeons have excised the vesical mucous membrane and implanted the ureters in the rectum or sigmoid. The chief objection to this is the liability to infection of the ureters from the bowel, resulting in ascending nephritis. Maydl has, however, largely overcome the risk of infection by implanting the whole trigone into the rectum, thus retaining the valvular orifices of the ureters. Brandsford Lewis,[1] in a review of this subject, quotes a number of cases operated on by Maydl's method. The following case, operated upon by Dr. Herezel, of Buda-Pesth, will serve to illustrate what may be hoped for as a result of this operation :

"A boy five years old was operated on in May 1897. In March 1898 his condition was reported by the operator as admirable. Quantity of urine 1000–1200 cubic centimetres in twenty-four hours ; specific gravity 1013 ; slight amount of albumen, no pus. The boy was able to hold the urine five hours at a time, and then to eject it in a good stream from the rectum. In August 1899 (a year and a half after the operation), the condition continued as satisfactory. The patient, now a rapidly growing and strengthening boy, enjoyed living, retaining his urine for six or seven hours during the day-time, but relieving himself oftener at night, or running the risk of wetting the bed while in deep sleep."

The same author also quotes the results of seventeen operations by Maydl's method, collected by Nové-Josserand. There were two deaths, one from shock and the other from infection. " The secondary accidents noted were fistulæ of the urinary passages with an accompanying localised peritonitis, all of which cases recovered. Pyelonephritis, as the result of ascending infection, resulted in the death of one case after a period of four months. Urinary continence was perfect in all the cases excepting two. The patients were able to hold their urine for at least three hours, sometimes six or seven hours, and in one case throughout the night. The urine was voided sometimes mixed with fæcal matter, sometimes alone. The tolerance of the rectal membrane was perfect."

[1] *Ann. of Surg.*, June 1900.

Dr. Watson[1] collected forty-two cases of Maydl's operation, and found that nine deaths had occurred (mortality 21 per cent.), and that three of the deaths were attributable to the rectal implantation *per se*.

Dr. Hartley[2] refers to forty-six cases, with a mortality of 15 per cent.

Orloff[3] collected fifty-six cases, with eleven deaths (mortality 17 per cent.), within twenty-one days.

Although the danger of death from ascending septic infection of the kidneys is very much less than with direct implantation of the ureters without preservation of their valvular orifices, yet the risk is a real and considerable one. Some of the patients have died from this cause within a few weeks, and others after one or more years. The dangers of shock and peritonitis are also great, for the operation is a long and difficult one, which has sometimes taken over two hours to perform.

Four of the deaths in Orloff's collection were due to peritonitis, two to pneumonia, one to the anæsthetic, and one to hæmorrhage. Of the forty-five who survived the operation five died later from ascending infection. Of Orloff's own four cases one died from this cause in a fortnight, and another after two years. It is fair to state, however, that a number of these patients were already suffering more or less from renal changes at the time of the operation.

Function. The rule is that the rectum gradually or even rapidly acquires the power of retaining the urine, for several hours, without any appreciable sign of irritation. During the day the control is almost perfect, but incontinence or reflex evacuation is not uncommon at night. Nine of the cases collected by Hartley had been seen three years after the operation, and one after seven years. Thirteen had been seen two years after the operation.

Complications and Sequelae. Seven of Orloff's collected cases had developed fæcal fistulæ, and in three of these a secondary operation became necessary on this account. Pneumonia occurred in six of Orloff's cases, with two deaths. In one case obstructive kinking of the ureters has caused death.

In spite of the fact that this operation is undoubtedly more severe than the plastic method, the immediate and the late results, in those that survive, are far better than those of the best of the older methods. The mortality of the operation is really greater than the figures quoted above would indicate, and time has shown that the late results are not so perfect as some surgeons anticipated, because ascending infection has not been uncommon. It must be remembered, however, that renal infection has been frequent after plastic operations, and that the condition of these patients, if left alone or submitted to plastic operation, is truly miserable, so that it is worth while to run a considerable risk to gain a tolerable result.

OPERATIONS.

(1) **The construction of a bladder.** (*a*) Wood's plastic method, and some modifications of it ; (*b*) Trendelenberg's operation ; (2) **The transplantation of the ureters into the urethra, Sonnenburg's operation ;** (3) **The diversion of the urinary steam into the intestine :** (*a*) Frank's method ; (*b*) Maydl's method ; (*c*) Moynihan's method.

[1] *Ann. of Surg.*, 1905, vol. xlii, p. 813.
[2] *Med. News*, August 29, 1903.
[3] *Ann. de Mal. de Gen. Urin.*, No. 11, 1902.

(1a) **Wood's Operation.**

Age. The cure of the ectopia may be commenced after the child is four or five, and should be completed, if possible, by puberty. In this case the epispadias may be taken in hand and completed before adolescence, when the growth of hairs and sexual desires will interfere much with the union of the flaps.

Unfavourable Conditions.[1] 1. Large size of the ectopia, with much bleeding and some purulent discharge from the surface. 2. A sickly condition of the patient, pointing to poor powers of repair, and a waddling gait, to wide separation of the pubes. 3. Tendency to cough. This increases the protrusion. 4. Presence of large herniæ. 5. Secondary dilatation of the ureters and pelves of the kidneys, with degeneration of viscera. Mr. Wood (*loc. supra cit.*) shows that sometimes the above complication may be recognised by the presence of more albuminuria than is accounted for by the amount of cystitis. In other cases no such signs are present. Out of forty cases a fatal result, chiefly from this cause and undetected, followed in four. 6. Obstinate eczematous rawness. 7. Small size of the scrotum. This is rare.

Preparatory Treatment. If the patient has passed puberty, and the hair is at all abundant, depilation should be practised, and nitric acid applied at intervals to the groups of hair-follicles.

It may be well also to try and diminish the size of the ectopia by the means adopted by the late Mr. Greig Smith, who, for some weeks previous to operation, kept the patient on his back, and the exposed mucous membrane shielded with green " protective " coated with dextrine, covering this over with boracic lint, and by this means, in one case, the mucous membrane not only became less angry, but its upper half, almost as low as the ureters, became covered with epidermis almost as white as the surrounding skin. In another case, also successfully operated on, no preliminary treatment was of any avail in diminishing the size of the ectopia.

Operation. An anæsthetic having been given, a median flap[2] is raised from the abdominal wall above the exposed bladder. Its shape resembles that of the wooden portion of a fire bellows, its length is rather greater than the distance between the root of the penis and the upper margin of the exposed bladder, while its root must be sufficiently broad to ensure a sufficient blood-supply. In raising it, care must be taken not to cut it too thin, and, at the same time, not to go too deeply with the point of the knife, as the tissues here are extremely thin, and the flat, tense, expanded linea alba beneath is often very thin, and thus the peritoneal sac may easily be opened.

The two groin flaps are next made, of rounded oval shape, with broad pedicles, the outer boundary of which is sufficiently carried out on to the thigh, and then on to the root of the scrotum, to ensure its containing the superficial epigastric and external pudic arteries. The inner margins of these flaps join those of the central flap at about its

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[1] For full information on all these matters Mr. J. Wood's articles (*Dict. of Surg.*, vol. i, p. 425, and *Med.-Chir. Trans.*, vol. iii, p. 85) should be consulted.

[2] The shape and arrangement of the flaps are excellently shown in pl. ii, Figs. 1 and 2, accompanying Mr. Wood's paper (*Med.-Chir. Trans.* vol. lii). Some illustrations of other flaps in a paper by Mr. Mayo Robson (*Brit. Med. Journ.*, 1885, vol. i, p. 222) will also be found useful. And I would direct my readers' attention to a paper by the late Mr. W. Anderson (*Clin. Soc. Trans.*, vol. xxv, p. 78), which contains, as might be expected, some very helpful drawings.

centre, and are then continued down along the side of the urethral groove for about half its length.

While these flaps must be cut as thick as possible, care must be taken to avoid any subsequent hernia, and they must be sufficiently detached to meet for their whole length, without tension, in the middle line. In raising them they must be handled as carefully as possible, whether with fingers or with bluntly serrated forceps, so as in no way to impair their vitality. All bleeding having been stopped, the flaps washed with boracic acid lotion, and their surfaces allowed to become glazed, the umbilical flap is first taken and folded down, with its skin surface towards the bladder, evenly and without tension. It is then stitched with catgut to the cut edges, above the root of the penis.
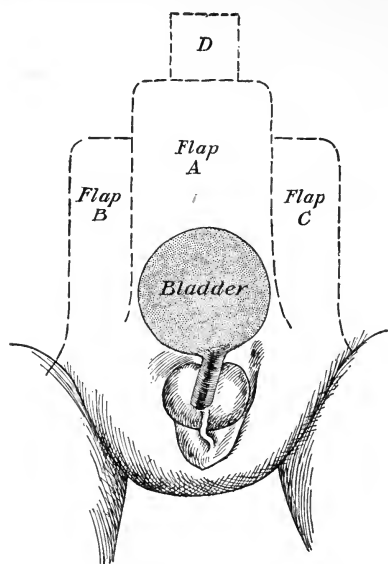
FIG. 273. Wood's operation for ectopia vesicæ (Binnie). Flap A is turned down to form the anterior wall of the bladder, and D may be added to cover the urethra. Flaps B and C are displaced inwards to cover the raw surface of flap A.
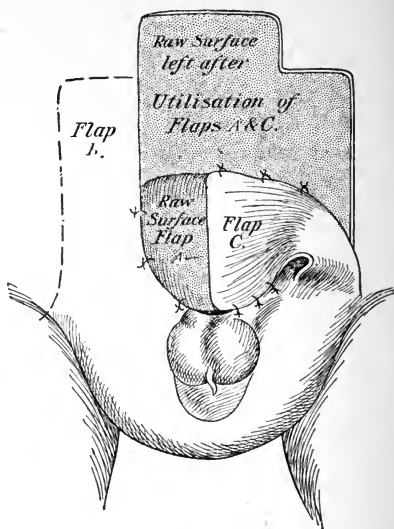
FIG. 274. Wood's operation for ectopia vesicæ (Binnie). The raw surface is lessened by approximation of the edges, and covered with skin-grafts.

The groin flaps are then drawn inwards, placed with their raw surfaces upon the raw surface of the umbilical flap, and carefully stitched together with fishing-gut.

The raw surface from which the central flap was taken is then closed, as far as possible. The rest of this wound may be closed, now or later on, by Thiersch's method of skin grafting.

The parts are covered with antiseptic dressings which are frequently changed, and the buttocks and hips smeared with eucalyptus and vaseline. If any redness appear, wet boracic acid lint dressings should be made use of.

(1 b) **Trendelenberg's Operation.** Prof. Trendelenberg[1] published a case of extroversion of the bladder in which immediate union of the

[1] *Centr. f. Chir.*, No. 49, December 1885.

lateral margins was obtained by previous division of the sacro-iliac synchondroses. By entirely freeing the joints this surgeon has gained an approximation between the anterior superior spines of two inches in a child of two and a half. This approximation is of course only rendered possible by the fact that the symphysis pubis is deficient in these cases. When the bones are thus approximated the lateral margins of the defect are pared, and brought together with sutures. This, when successful, effects a great saving of time, and secures that the cavity of the bladder shall consist, save for a narrow line of scar in front, of vesical mucous membrane and not of scar tissue. As a result the formation of phosphatic deposit is greatly diminished. A very interesting account of this operation has been given by Mr. Makins, with a successful case.[1] To be successful the division of the synchondroses should be performed early, *e.g.* before the child is eight.

Prof. Trendelenberg read a paper before the American Surgical Association, giving his views and the instructive results of his mature experience.[2] He maintains that the bilateral separation of the sacro-iliac joints in children before the seventh or eighth year is not the serious procedure that some consider it to be, and that it is very effectual in relieving lateral tension. He believes that transplantation of the trigone into the bowel will be again abandoned on account of the risk of pyelonephrosis, and the inconvenience of micturition through the anus, especially in a male.

By careful paring and re-formation of the neck of the bladder and urethra, he maintains that it is possible in at least some cases to obtain more or less perfect sphincteric control of the bladder, or failing this, to provide artificial control.

Of the cases operated upon by Trendelenberg years ago for defects extending from the umbilicus to the glans penis, three are alive and without any fistulous openings, but with a complete bladder and urethra. " The bladder when distended consists of a spherical cavity lined with mucous membrane over its greater extent. The passage of small concretions is occasionally observed by these patients, but the tendency to calculus formation is by no means as marked as in certain cases operated upon by Thiersch (flap method) which I have had occasion to examine.

" These patients partly suffered to such an extent from the production of calculi, incrustations, and ulcerations in the irregular crypts of the bladder, that they demanded operation by some other method for the relief of their condition.

" Retention of urine is not complete in any of my three cases. These young men, therefore, wear a contrivance supplied with a small spring which compresses the urethra at the root of the penis, either from the front or the back. The patients are now students at college ; they are not greatly inconvenienced by the apparatus, and by proper care and attention they avoid the production of any odour which would serve to attract attention to their condition. If the spring is raised the urine issues forth in a stream. On lying down it collects in the bladder without leakage. One of the men remains dry throughout the night, he may be awakened once or twice by the desire to urinate, and even when he gets up he can voluntarily retain the urine for several minutes, and then pass it naturally in a stream. A fourth patient, a boy of five,

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[1] *Trans. Med.-Chir. Soc.*, vol. lxxi, p. 191.
[2] *Ann. of Surg.*, 1906, vol. xliii, p. 281.

could also, when he tried, retain his urine for several hours when standing or walking, but later on at the time of his leaving the clinic the ability was lost.

" Both of the two cases last mentioned demonstrate that physiological factors necessary for both retention and voluntary micturition are present, and that they are merely prevented from functionating in a normal manner by certain mechanical conditions. The reason for the failure may be accounted for by the fact that the two sections of the pelvis, which have been separated at the sacro-iliac synchondrosis, have a tendency gradually to resume their former positions ; therefore the neck of the bladder and the prostatic portions of the urethra, which are closely connected with the pubic bones, are pulled upon to such an extent that the muscular ring can no longer be brought into play.

" I have made several attempts to overcome this difficulty by mobilising the pubic bones, with the help of the chisel, or by dissecting widely the attachments of the urethra and the neck of the bladder to the latter. In no instance of complete ectopia have I been favoured, however, with a permanent result. Such procedure, moreover, is apt to lead to the production of a dense scar along the vesical neck, which in the event of a late secondary operation will be found a source of as great annoyance as the cicatrices in a hare-lip which has failed to heal by primary union."

Cases of partial ectopia or of epispadias and incontinence are more favourable, and Prof. Trendelenberg has been able to obtain excellent results in a few of these by paring freely enough and carefully suturing the vivified edges of the urethral groove or deficiency in the lower part of the bladder. The margins of the vesical part of the wound are inverted. During these procedures the pubic bones are strongly retracted, and the pelvis is elevated.

Only a fine drainage-tube is left in the newly completed urethra, for a catheter might exert too much pressure on the sutured tissues. The bladder is drained through a special opening until healing has occurred.

In the case of a female child with epispadias and incontinence, Prof. Trendelenberg was able to suture the pubic bones together after separating the right sacro-iliac joint and suturing the urethra and neck of the bladder. Success did not attend the operation, which was therefore repeated. This time the result was good, and it remained perfectly satisfactory six years later.

It is rarely possible to complete the pubic arch in cases of extensive ectopia, and " wiring of the bones, particularly in boys, cannot be advantageously employed, because the wire comes in conflict with both the bladder and the penis. In younger children, moreover, the wire is very apt to cut its way through the tissues." [1]

Trendelenberg believes that this approximation can be best accomplished by the gradual effect of pressure by means of an elastic pelvic girdle worn day and night. This method is most likely to be successful when adopted after separation of the bones at both sacro-iliac joints. When the pubic gap has been greatly diminished, a plastic operation can be undertaken for reconstructing a bladder and urethra.

It may be safely concluded, I think, that the results of Prof. Trendelenberg are as good as any that can be obtained by any plastic method, even with the advantage of unusual skill and long experience, but the

[1] Trendelenberg, *loc. cit.*

functional results are not encouraging except in cases of partial ectopia and epispadias with incontinence.

König has lessened lateral tension by dividing the rami of the pubis and ischium, and Schlange has adopted a similar method.

Segond has liberated the upper part of the bladder without opening the peritoneum, and brought it downwards as a flap, and sewn it to the refreshed lateral margins of the urethral gutter and sides of the trigone, He then made a transverse incision through the base of the pendulous prepuce and brought the penis through this aperture. The prepuce was then used to cover the raw surface of the flap on the dorsum of the penis. After this operation the urine can be more easily collected and conducted into a suitable urinal.

After-treatment. The patient must be partly sitting, the shoulders being well propped up and the knees flexed ; a bandage passed from the knees around the shoulders will facilitate this. Any sudden straightening of himself by the patient is fatal to a good result. For the first few days small opiates or injections of morphia will be required.

(2) **Sonnenburg's Operation** consists in transplantation of the ureteral ends into the upper end of the gutter which represents the urethra. The rest of the vesical mucosa is resected without opening the peritoneum A suitable urinal can be worn after this procedure with comparative ease. The gap in the parietes can be closed either completely or in part by the appropriate use of flaps. It is less dangerous, but also far less satisfactory, than Maydl's method.

(3a) **Anastomosis of the Bladder and Rectum.** Frank [1] makes an incision in the posterior wall of the bladder and anastomoses the bladder and rectum by means of his absorbable coupler. He then frees the edges of the bladder, turns them in, and sutures them together. Dr. Halstead frees and turns in the thick mucous membrane only, leaving the fascia behind, so that the peritoneum may not be opened. He uses Murphy's button for making the anastomosis. Direct suture is preferable.

The abdominal wall is then closed as far as possible. Senn (*loc cit.*) performed the operation in two stages, first making a longitudinal incision in the bladder, through which he drew a piece of rectum or lower part of the sigmoid, and fixed it to the bladder wall. Three days later the bowel was opened, and the edges of the mucosa were joined to the mucous membrane of the bladder.

A plastic operation to close the bladder was undertaken later, but this did not succeed at the first attempt.

This plan is not so satisfactory as direct implantation of the trigone into the bowel, for the attempt to preserve and close the ectopic bladder is attended with more frequent failure or formation of fistulæ, which may discharge either urine alone or fæces also. It is probable also that calculi will form in the vesical diverticulum which communicates with the rectum, unless the fistula is a wide one.

Further it is not necessary to save the whole of the bladder, for the rectum soon affords plenty of room for the urine.

(3b) **Maydl's Operation. Transplantation of the Trigone into the Sigmoid Colon.** An area of the bladder, including the trigone, is then carefully dissected up and separated from the rest of the bladder and commencement of the urethra. The excess of the vesical mucosa is

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[1] *Ann. cf Surg.*, vol. xxxvii, p. 291.

then excised and the field of operation thoroughly cleansed before the abdomen is opened in the middle line.

A loop of sigmoid is now drawn through the wound, and the abdominal cavity protected by gauze packing. A longitudinal incision of the required length is next made in the right side of the exposed loop of sigmoid, escape of contents being prevented, if necessary, by the application of clamps. The trigone is now rotated through about ninety degrees, so that the ureters now lie above one another instead of side by side, and is attached to the margins of the opening in the sigmoid by means of sutures.

Two sutures are used, a continuous deep one of catgut piercing all the coats in order to secure a firm hold until union occurs, and a superficial continuous Lembert or Cushing suture of fine silk (*see* Fig. 275 A and B).

The sigmoid is cleansed and dropped back into the abdomen, and the wound closed.

A   B
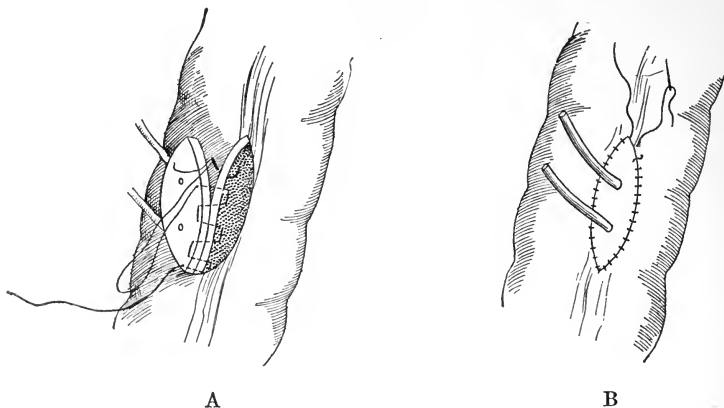
FIG. 275. Maydl's operation. (Binnie.) A, The portion of bladder is sutured into the sigmoid colon; the deep suture penetrates all the coats. B, the deep suture is reinforced by a continuous Lembert suture.

Maydl considers the sigmoid to be preferable to the rectum for implanting the trigone, because he believes the risk of ascending infection to be less on account of the comparative emptiness of the sigmoid.

Gersuny's modification of Maydl's method adds to the severity of the operation without conferring any real advantage. He divides the bowel across at the junction of the sigmoid and the rectum, implants the trigone into the upper end of the rectum, and the sigmoid into the wall of the rectum lower down.

Dr. Peters, of Montreal, successfully transplanted the ureters into the rectum extraperitoneally. The patient was six years of age at the time when Dr. Peters recorded the case. The urine could be retained in the rectum for three hours during the day and for eight hours during the night. This may be quickly done in the following simple way. A catheter is passed into each ureter, and sewn in, and the lower inch of the ureter is isolated; a fine curved sinus forceps is passed into the clean rectum, and forced forward into the wound below the ureter, where it grasps the catheter and draws it and the ureter into the rectum. A couple of sutures close the small wound in the bladder. When the

operation has been completed the two ureteral catheters project from the anus. They loosen and come away within a week.

(3c) Transplantation of the Whole of the Ectopic Bladder into the Wall of the Rectum. Sir Berkeley Moynihan [1] successfully transplanted nearly the whole of the ectopic bladder into the rectum in a young man aged 19. "A plastic operation had been performed fifteen years earlier, but the lower part of the vesical mucosa was still exposed, and the urine was discharged upon the exposed surface. It was there caught in the usual rubber receptacle, of pestilent odour, and drained downwards to the leg. The patient, with increasing years, had become more painfully aware of the misery of his condition, and begged to have something, anything, done to relieve him of his terrible affliction."

It occurred to Moynihan that "if a large area of the bladder could be grafted, so to speak, into the rectum, the capacity of the bowel
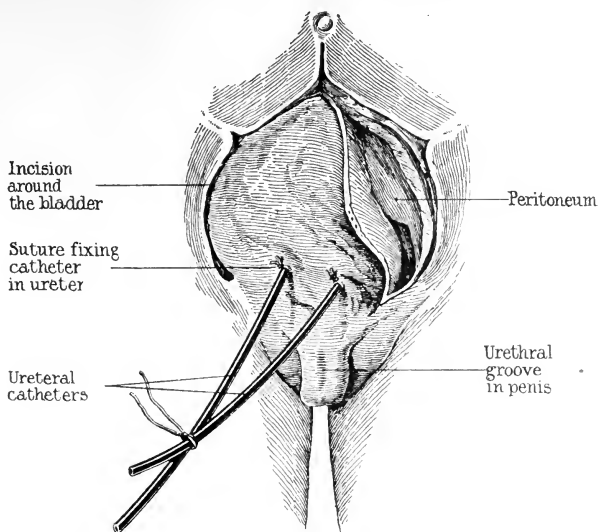
Fig. 276. Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum (redrawn from the *Ann. of Surg.*). The bladder is carefully liberated without opening the peritoneum. The ureteral catheters are fixed in position by sutures.

would be increased, and a veritable cloaca formed. My only doubt was that the vascular supply furnished along the ureters might be insufficient for a large area of the bladder. But in the operation I now describe I found that when the edges of the bladder were trimmed with scissors, a free oozing of blood occurred from the cut surface. I therefore was able to transplant the entire bladder."

Operation. "The ureters were first catheterised. Owing to the previous constant friction against the exposed bladder mucosa, which pouted exuberantly, this little manœuvre was by no means easy. A catheter was passed for four inches into each ureter, and was fixed there by a single stitch, which caught up the tube on one side and the bladder on the other.

"A vertical median incision was then made from the exposed bladder mucosa towards the umbilicus, the flaps which had been turned over to

[1] *Ann. of Surg.*, 1906, vol. xliii, p. 237.

the middle line in the previous operations being completely cut through. On turning aside the flaps thus made the upper previously covered mucous surface of the bladder was exposed ; it was found to be smooth, thin, and entirely different in character and appearance from that of the lower exposed part. An incision all round the margin of the mucous membrane of the bladder was now made between the mucosa and the skin, and the incision was deepened by degrees until a good thickness of the bladder could be raised up.

" The dissection from the margin of the bladder towards the ureters was continued round the whole circumference little by little. This was
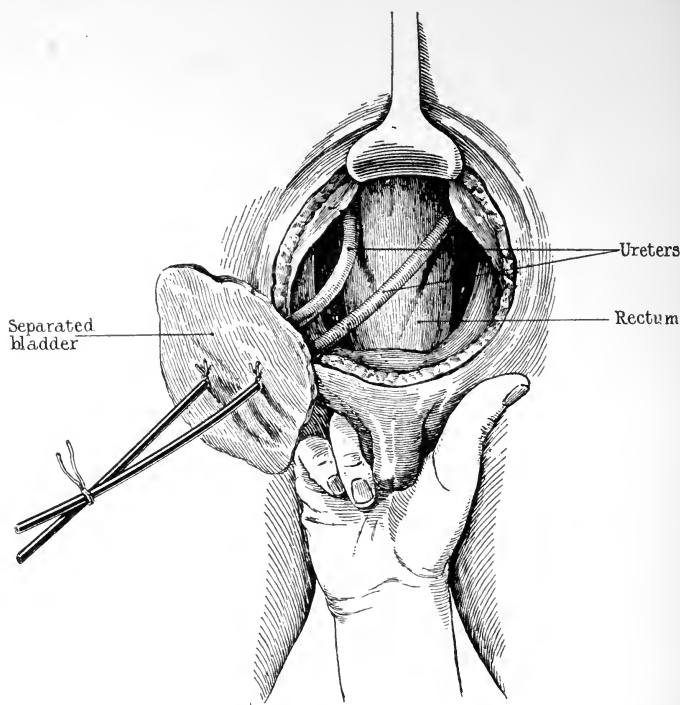
Fig. 277. Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum (redrawn from the *Ann. of Surg.*). The ureters are not separated nearly so freely as shown in the figure.

difficult in part owing to the fact that there was much scar tissue left from the former operations, in part because the great vascularity demanded frequent cessation to restrain hæmorrhage by pressure. The separation above the pubes was most difficult, and here the prostate had to be separated with great care.

" The purpose of this process of separation was to isolate the whole of the bladder, leaving only as its pedicle, so to speak, the two ureters. As much tissue was left round each ureter as possible, so as to avoid the possibility of damage either to the ureter itself or to its vessels. In the annexed diagram (Fig. 277) the ureters are shown clearly defined. This was not their condition during the operation. The figure is drawn only for the purpose of making the details of the operation clear. As soon as the bladder was well isolated, it was drawn forwards towards

the umbilicus and there held by an assistant. In the bottom of the wound the rectum was now seen, and above the peritoneal reflection on to it. The serous covering was then stripped upwards from the front of the rectum until four or five inches of the bowel lay exposed at the bottom of the wound. In stripping the peritoneum up a small rent was made into it, which was closed at once by a continuous catgut suture.

"The finger of an assistant was now passed into the rectum to make it prominent, and along the anterior surface of the bowel an incision about three and a half inches in length was made (Fig. 278).

"The upper and lower ends of this incision and the mid points of the sides were held with small vulsella, until a large opening was made. Into this opening the bladder was placed, being turned upside down, so that its former anterior surface became posterior, and its former lower end became the upper.

"The ureters, instead of passing forward to the bladder, passed backward, and the catheters passed into the rectum and out at the anus. The edge of the bladder and the cut edges of the rectum were now sutured together by two stitches that were continuous, one taking the right side and the other the left (Fig. 279). The sutures were passed after the manner of Lembert, so that no mucous membrane was included in them. A few additional interrupted sutures were

FIG. 278. Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum (redrawn from the *Ann. of Surg.*).

necessary here and there. When the sutures seemed to be securely uniting the bladder and the rectum, the wound was dried, and the skin edges along the original median incision were drawn together. At the upper end the edges came well into apposition, but about an inch at the lower part had to be left open. The catheter which had been introduced into the ureters now passed out of the anus; the sphincter had previously been stretched. The operation lasted an hour and a half. The after-progress of the case was satisfactory. The catheters remained in the ureters for four days, the urine being collected into a bottle. After their removal the urine passed into the rectum, and dribbled out at the anus, which, owing to the stretching of the sphincter, as yet exerted no control. On

the seventh day a little urine began to leak by the abdominal wound, and this continued for a week. On the fifteenth day an anæsthetic was again administered, and the leaking point in the former line of suture discovered and made good. From this day the wound remained absolutely dry, all urine escaped by the rectum, and control gradually returned, until at the end of the month it was perfect. Urine was then passed by the rectum about every two hours. The interval between the acts of emptying the rectum has gradually increased until now (November 1905) the shortest period is three hours, and the longest five hours. The urine is quite sweet and is normal on examination.

" When the rectum is now examined, the line of junction between the mucous membrane of what was the bladder and the mucous membrane
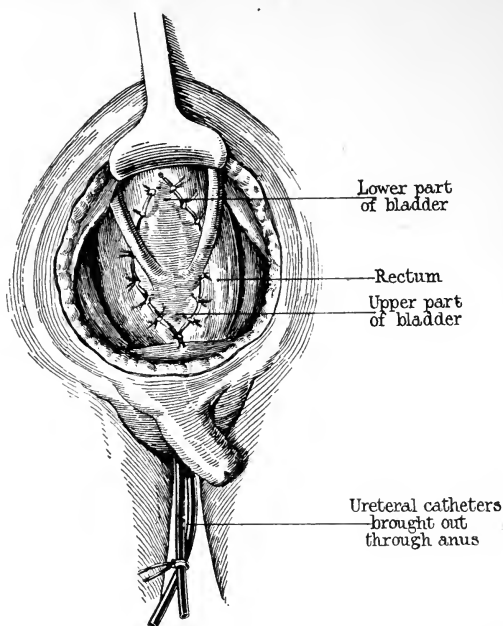
FIG. 279. Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum (redrawn from the *Ann. of Surg.*). The bladder has been rotated so that its upper end is now lowest and fixed to the lower part of the wound in the rectum. The ureteral catheters are brought out through the anus.

of the rectum cannot be distinguished. All feels smooth and even and continuous. There is a fairly capacious cloaca."

In February 1907 Sir Berkeley Moynihan very kindly sent me a letter which he had just received from the medical attendant, Dr. Empey. The following is an extract from the letter : " He is following the occupation of weaving, and presents the appearance of possessing excellent health. There is slight suppuration of the wound in front still going on, but nothing of importance. He requires to empty the rectum four or five times in the twenty-four hours. The longest interval, I am given to understand, is from three to four hours during the day. He very occasionally wets the bed a little."

OPERATIONS FOR DISEASES OF THE PROSTATE

THE TREATMENT OF ADENOMATOUS ENLARGEMENT, OR SO-CALLED SENILE HYPERTROPHY. MALIGNANT DISEASE. PROSTATIC ABSCESS. PROSTATIC CALCULI

ENLARGEMENT OF THE PROSTATE—ANATOMICAL AND PATHO-LOGICAL CONSIDERATIONS

THE human prostate is formed by the fusion of bilateral accessory sexual glands, which remain separate in lower animals. The normal organ weighs 4½ drachms upon an average, but it is subject to considerable variation, and prostates weighing as little as 2 or as much as 6 drachms may be quite normal. As a rule obstruction does not arise until the gland is much larger than this, but occasionally quite small enlargements, especially of the hard or fibroid type, may make a patient entirely dependent upon a catheter, the fibroid contraction, with or without local outgrowths into the urethra, serving to interfere very seriously with the size and shape of the passage.

The effect of any given enlargement also depends very largely upon the rigidity or laxity of the fascial sheath of the prostate, and upon the presence of any local outgrowths into the urethra or bladder.

Prostates weighing no more than three-quarters of an ounce have caused complete and permanent obstruction, while in others the obstruction has not become serious until the soft gland has reached enormous dimensions, and has attained the weight of 5 or 6 or even more ounces.

It is important to remember that the prostate is (1) enclosed within a *true fibro-muscular capsule,* and (2) surrounded by an *external fibrous sheath* derived from the pelvic fascia (*see* Fig. 293, p. 696).

(1) In the normal condition the capsule is intimately attached to the gland, so that it is practically impossible to enucleate the latter from within this covering. In the enlarged prostate, however, things are very different, for a laminated and thicker pathological capsule now surrounds the adenomatous gland. This is derived from the fibro-muscular tissue and other parts of the prostate, which have not taken a share in the adenomatous change and have become displaced outwards by the growth, as pointed out by Mr. Cuthbert Wallace.[1]

The enlarged prostate is enucleated from within this pathological capsule, or the separation takes place between some of the laminæ, so that thin layers of fibres are often seen encircling the prostate, when the latter is removed in one piece (*see* Fig. 282). Very little bleeding

[1] *Loc. infra cit.*

need occur when the pathological capsule has formed, and when the operator keeps within the proper layer.

(2) The fibrous sheath is derived from the pelvic fascia. The external layers of this are very dense, but towards its inner surface it is less firm, and harbours the prostatic plexus of veins. Mr. Freyer main-

Sheath and cap-
sule blended
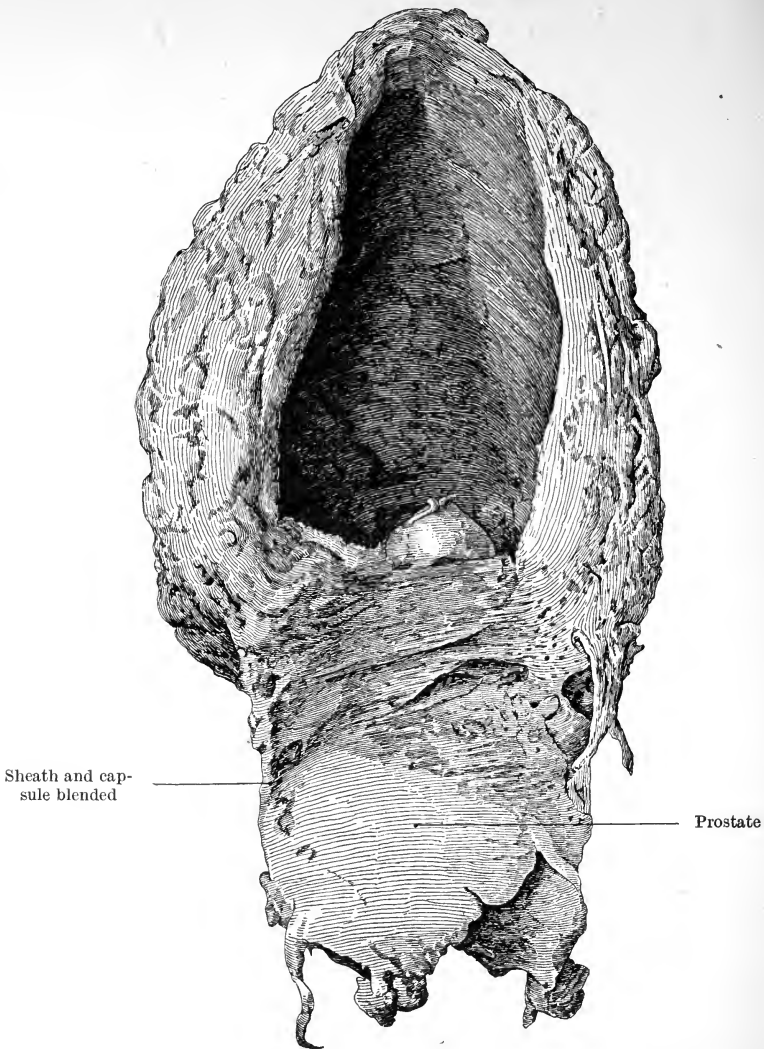
Prostate

Fig. 280. The bladder and the prostate. The attachments between the fibrous sheath and the true capsule are so intimate that enucleation would be very difficult or impossible. (Watson, *Ann. of Surg.*)

tains that the enucleation is performed between the sheath and the capsule.

As pointed out years ago by Sir Henry Thompson, there is no such thing as an anatomical or a physiological middle lobe ; it is a pathological product, and is generally, if not always, a process derived from one or both of the lateral lobes. The vesical projection is usually most

evident just behind the vesical orifice of the urethra, and on the middle line, because of the directing influence of the muscular bands which extend down to the urethra from the ureteral ends, as pointed out by Mr. Thompson Walker.[1]

The fact that the so-called median lobe is merely a prolongation from the lateral lobes is of the highest significance, for it is clear that removal of the vesical projection is not likely to grant permanent relief, for the prostate, which has produced an offshoot, is more than likely to go on growing, and to obstruct the urethra by lateral compression sooner or later. Below, the fascial sheath is attached around the urethra to the triangular ligament, which offers a strong and impassable barrier to the enlarging gland, which therefore projects upwards towards the base of the bladder, where the sheath is incomplete. Submucous processes therefore project upwards, by the side of the vesical orifice, and between this and the circular fibres which surround it and form one of the sphincters of the bladder. The sphincter constricts the base of the vesical projection, so that the greatly enlarged prostate often assumes the shape of an hour-glass. It is probable that the fibrous ring formed by the attachment of the lateral and anterior true ligaments of the bladder to the neck of the latter also exercises an influence in the same direction upon the shape of the enlarged prostate. From near the vesical neck the true ligaments become reflected downwards to form the dense fibrous sheath of the prostate, and upwards in a thinner layer which becomes lost upon the bladder, to the lower part of which it forms a fibrous covering. When the enlarged prostate is enucleated, the separation should always take place within the fibrous sheath, and also within at least a part of the pathological capsule. In this way the prostatic plexus of veins is not opened, and the risks of severe hæmorrhage and phlebitis are minimised. The pelvic cellular tissues are not opened, so that cellulitis of the delicate and loose tissues which surround the bladder and the other pelvic viscera should not occur if the operation is properly conducted well within the fibrous sheath. This tissue is, however, opened in exposing the bladder in the suprapubic operation, and in the perineal operation it is also traversed between the bladder and rectum. Fortunately no harm arises in the great majority of cases, because of the free drainage which is provided in both operations ; opportunity for extravasation into the loose tissues is therefore rarely afforded.

In some cases, however, the true or the ill-developed pathological capsule may be so adherent that real enucleation is an impossibility (*see* Fig. 280).

An inexperienced surgeon performing the suprapubic operation may fail to find the proper layer for separation, and then he will either effect an incomplete removal of the prostate, or, on the other hand, he may tear or cut through the fibrous sheath and invade the delicate and loose pelvic cellular tissues. The one mistake is liable to be followed by a stricture or recurrence of the enlargement, while the other may result in severe hæmorrhage from the prostatic plexus or in disastrous pelvic cellulitis. For these reasons the finger is infinitely better than any instrument for enucleating the prostate from above the pubes and within the bladder. It is of supreme importance to commence the enucleation between the proper layers, and in order to do this the mucous

[1] *Med.-Chir. Trans.*, 1904, p. 404.

membrane of the bladder must be incised over the prominence of the vesical projection, where the prostate is covered only by mucous membrane. The incision should also be within the widened circle of the sphincter, which surrounds the base of the part which projects into the bladder. Generally the incision can be most advantageously made a little behind the funnel-shaped urethral orifice, and upon the so-called median lobe. When this does not exist, the opening may be made over a lateral projection.

Indications for Operation. The ideal conditions for operation are—(1) A prostate moderately but not hugely enlarged—one that has loosened within its coverings by the separating action of the enlargement. Very greatly enlarged glands are difficult to remove even suprapubically because of impaction in the pelvis, and the difficulties of the perineal operation under these circumstances are still greater. If the prostate is **soft and movable** on rectal palpation, carcinoma is extremely unlikely, although microscopic examination not uncommonly reveals early carcinoma in an adenomatous prostate. If the prostate is as large as a Tangerine orange it will probably shell out well. A very slightly enlarged prostate does not shell out nearly so well, except when suprapubically it sends distinct protrusions into the bladder as shown by cystoscopic examination.
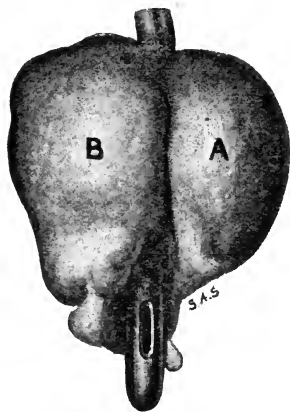
Fig. 281. Prostate weighing only three-quarters of an ounce (Freyer), outgrowth into bladder. The patient was entirely dependent upon a catheter.

(2) Above all, the absence of renal sepsis and degeneration from backward pressure and other causes. The operation should be undertaken, if possible, before the output of urea has been seriously diminished by long-continued obstruction and secondary fibroid changes in the kidneys, and especially before the development of cystitis, pyelitis, or ascending nephritis.

(3) The absence of signs of malignant growth of the prostate or bladder. There is considerable evidence to show that the adenomatous prostate is more liable than is a normal one to become malignant, possibly as a result of the chronic irritation associated with it and with catheter life.

(4) The absence of much impairment of the general health and of serious disease of the vital organs.

To get the great advantages of operating under these favourable conditions as far as possible it is best to operate before the obstruction is sufficient to need the habitual or even the occasional use of a catheter for its relief, for, except under quite exceptional circumstances, catheter life is bound to lead sooner or later to cystitis and ascending septic changes, which may either terminate the life of the patient from septicæmia within a few days, or may subside for a time only to be repeated again and again, until the chances of surviving an operation, and of a complete local relief and recovery of the general health, are very materially diminished. It is best of all to operate before the residual urine becomes more than about 2 or 3 oz., even when a catheter has never been used before, unless the residue can be drawn off once daily under circumstances which are unusually favourable for preventing infection of the bladder.

Residual urine is very apt to become foul either from infection by a catheter or from the rectum. The degree of disability in micturition and the amount of residual urine are far more valuable than the apparent size of the prostate as ascertained by rectal and bimanual examination, for it is a matter of common knowledge that the size of the prostate does not bear any constant relation to the disability. A cystoscopic examination helps very considerably in suitable cases, for a vesical projection or a collar may be seen, and the condition of the bladder ascertained (see Fig. 281). In some cases a pouch or a calculus may be seen, as in many of my cases; in others carcinoma of the bladder is a surprise; but it must not be forgotten that neither rectal nor vesical examination, even through a suprapubic wound, may discover any enlargement which appears to be sufficient to produce an obstruction that is known to exist. In such a case the prostate is unusually firm and only slightly enlarged as felt per rectum, but the urethra is nevertheless obstructed. The following case may serve to illustrate this point, and it also presents several other interesting and unusual features:

The patient, who was only 48 years of age, was brought to see one of us (R. P. R.) by Dr. Evan Evans, now of Lampeter, who had seen the patient in consultation with his usual medical attendants at Aberayron. The patient gave a history of difficulty in micturition for about seven years off and on, and for the last two years he had been practically dependent upon a catheter, which he had learnt to pass after several attacks of acute retention. He had suffered much from acute and chronic cystitis, and had sometimes to pass the catheter every hour or two. Irrigation with a solution of silver nitrate had given some relief. The catheter entered without much difficulty, although the patient hated passing it on account of the pain, which he said was very severe. On two occasions he had journeyed to London to consult well-known surgeons, and one of these, with a great experience of urinary diseases, suggested a median perineal cystotomy after giving the doctor a diagnosis of congenital stricture of the neck of the bladder.

When I saw the patient in October 1905, the bladder had never been examined by means of the sound or cystoscope. The prostate was firmer than usual even, and slightly enlarged. The urine was foul, the total urea was diminished almost to half the normal, and the general health was considerably affected, although there was no sign of cardiac or pulmonary disease beyond a little chronic bronchitis.

The bladder was washed out, and the cystoscope was easily introduced; the beak immediately struck a stone of large size: therefore it was decided not to waste time upon a further examination. Suprapubic cystotomy was performed, and the stone was removed.

On sweeping the finger round the bladder two pouches were discovered, a small one to the right and posteriorly; the other, a much larger one, with a small orifice on the left wall of the bladder, extended towards the left iliac fossa, and contained a large stone, which was removed with great difficulty, for the small orifice contracted upon the finger and instruments. The stone, which was a phosphatic one, was crushed and ultimately removed. There was very little alteration of the urethral orifice of the bladder. The prostate was not removed because the operation had already lasted quite long enough. The patient was exhausted from chronic cystitis and pyelitis, and the excretion of urea was diminished. It was felt that the large stone, placed at the bladder base, might have been at least partly responsible for the obstruction. Four months later the patient returned greatly improved in general health, and with his urine in a fairly healthy condition, and containing far more, but not the normal amount of, urea; but he had not been able to pass any water in the natural way. The prostate was still firm, even upon the surface, and a little larger than normal.

The urethroscope was passed into the prostatic urethra with the hope of discovering the cause of the obstruction, and the lateral walls were seen to bulge inwards, so that the urethra consisted of a mere antero-posterior slit. Small whitish elevations, probably adenomatous, were seen upon the projecting surfaces.

A few days later the prostate was removed suprapubically, with unusual difficulty, for it was a small fibroid body which was practically incapable of enucleation,

the true capsule being adherent to the sheath, probably as a result of repeated attacks of prostatitis and cystitis.

Although the patient lost a great deal of blood, and afterwards vomited persistently for four days, he made a good recovery, and he is now, eight years after the operation, quite well and able to carry on his business. He can empty the bladder completely and easily, and he does not get up to pass his water during the night. The sexual power has returned, but seminal emissions do not occur. The vomiting was considered to be uræmic in origin.

It is curious that the patient's father, grandfather, and several uncles have suffered from enlargement of the prostate, some of them at unusually early ages.

Care must be taken not to mistake the hard, fixed, and nodular enlargement of the carcinomatous prostate for the adenomatous so-called senile hypertrophy.

When the catheter can be used under the most favourable circumstances complications may be long delayed, but sooner or later acute retention will supervene in the large majority of cases, and this may be accompanied by intra-vesical hæmorrhage, and followed by cystitis either from infection arising from the careless use of instruments, or from the rectum. Vesical calculi may slowly develop, and the kidneys may become affected.

Complete retention, incapable of relief by any catheters, even when used by an experienced surgeon, may develop at any time.

It is rarely wise to remove the prostate when an operation becomes necessary for complete retention. It is far better to be content with suprapubic drainage until the acute symptoms have subsided, for the congestion of the prostatic plexus is extreme, and the urine too often foul under these circumstances. Ascending nephritis and suppression of urine are especially likely to develop at this period. After a variable interval the prostate may be removed under more favourable circumstances, if the patient prefers this to either permanent drainage, or the almost certain return of his acute retention at no distant date. In a similar way preliminary drainage may be adopted in very feeble old men with much cystitis or chronic uræmia, and occasionally when large or encysted stones have been removed with delay and difficulty or severe hæmorrhage.

Unfortunately patients frequently do not seek treatment, or do not consent to any operation until some complication or other has made life a burden ; and they may not consent to an operation until grave changes have taken place in the kidneys. It then becomes a difficult question to decide for or against a radical operation. Similar difficulties arise in advising patients who are very decrepit, or suffering from cardiac, pulmonary, or other diseases. Under these circumstances the danger of the operation is considerably increased, and the advantages derived from it may be comparatively short-lived, on account of the general condition of the patient and the shortness of the natural expectation of life.

In the absence of evidence of grave interference with the renal function, however, suprapubic prostatectomy may be undertaken by a skilful surgeon, with a sufficient experience of this operation, if the general health is good enough to justify the administration of an anæsthetic. Spinal anæsthesia is very satisfactory in these cases, especially because it relaxes the abdominal muscles completely and thus makes the operation easier.

In many cases the question of operation will depend upon (a) the

possibility, or otherwise, of leading a catheter-life under circumstances which are favourable for avoiding septic infection ; (b) the degree of discomfort and disability involved by catheter-life in the given case ; (c) the risk of the operation for the patient under consideration, is it likely to be so great, on account of renal changes, general disease, or extreme age, as to make the operation inadvisable, although it would, if successful, give great relief as long as life lasts ?

In conclusion, it may be briefly stated that the cases in which, in my opinion, the operation is most called for, fall into two groups. A. *The more urgent.* (1) Where previous appropriate treatment, carefully carried out, has failed ; (2) where there have been one or more attacks of retention ; or (3) where hæmorrhage has taken place. In either case the peril of cystitis, too often fatal here, is enormously increased. (4) Where there is inability to micturate, but the patient is dependent upon the use of a catheter, and especially when he cannot pass this himself, or get some one to do it for him, with all the care and cleanliness that is necessary to prevent infection. This will depend largely upon the education and the means at the disposal of the patient ; in a hospital patient it is far safer to operate than to allow the patient to attempt to pass a catheter himself. (5) Where micturition becomes increasingly painful and frequent ; (6) where the passage of the catheter is increasingly difficult, with the risks of hæmorrhage, formation of false passages, &c. ; (7) where the prostate is soft and elastic, not densely hard and fibrous, the immediate risk of operating for the latter is greater, and the chance of a perfect result is less, but the prognosis is better when the perineal operation is chosen. Of course, the greater the power of voluntary micturition which remains, the more natural the urine as to urea, specific gravity, albumen, and sugar, the greater the rallying power of the patient, and the clearer the mind the better the prognosis. B. *Less urgent cases.* Here the operation is prospective and preventive. The patient is younger, the power of voluntary micturition is still good, there is no cystitis, but palliative treatment fails to relieve the frequent disturbances at *night*, and hæmaturia has begun to occur at intervals. Here the surgeon is abundantly justified in advising the operation as a preventive of worse things which are certain to come. The operation will not be often accepted here, but it is in such cases that it will give the best results.

THE CHOICE OF OPERATION

The choice lies chiefly **between suprapubic and perineal total enucleation.** Partial suprapubic prostatectomy and all other partial removals are unsatisfactory, either immediately or remotely or both.

Combined perineal and suprapubic operations are rarely necessary, although they may afford a better control of and access to the gland in fat subjects, and in some other difficult cases. The mortality is, however, considerably higher than when either the suprapubic or the perineal route is adopted alone.

(1) *Duration of the Operation.* The suprapubic operation can be more quickly performed than any other except in the rare cases of small and adherent prostates.

(2) *Ease.* The suprapubic is easier than the perineal operation in the great majority of cases, and this is especially true for very large prostates (Fig. 282) ; but it is not true for small glands, which do not

enucleate but have to be cut away, for it is a distinct advantage for the surgeon to see what he is doing in these cases.

(3) *Completeness of the Removal and certainty of Complete Relief.* The suprapubic route allows the removal of the gland *en masse* and surrounded by its true capsule. This is a distinct advantage, for the surgeon can be more certain of completely removing the prostate, whereas in the perineal operation the enucleation is always more or less piecemeal. Vesical projections are apt to be overlooked, and hence the relief is less often complete after the perineal than after the supra-
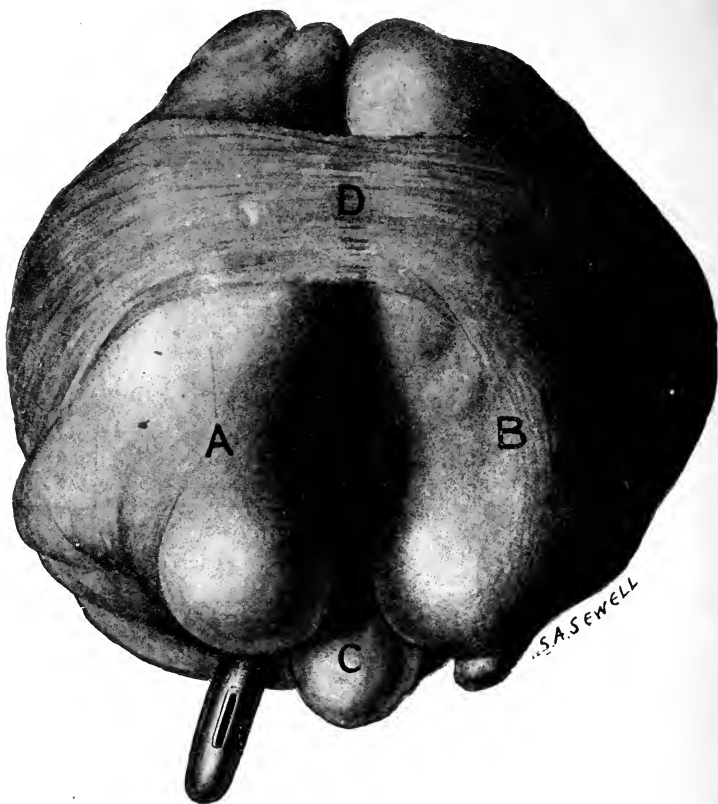
Fig. 282. Prostate weighing 10½ ounces, actual size. (Freyer.) A, Left lobe. B, Right lobe. C, Polypoid outgrowth from right lobe. D, Thin band of pathological capsule.

pubic operation, and under these circumstances stricture may develop. Such a serious sequel is very rare after a well-performed operation with adequate care in the after-treatment. I know of six cases in which it followed the suprapubic operation. In each case the prostate was hard, small, and difficult to remove. In these cases a catheter introduced occasionally during convalescence prevents stricture.

(4) *Exploration of the Bladder.* No one denies that a suprapubic cystotomy allows the most complete examination of the interior of the

bladder, and the best guarantee that calculi or sacculi or both may not be overlooked.

(5) *Incontinence of Urine.* This not uncommonly follows the perineal operation from interference with the compressor urethræ or its nerves or both. Dr. Ruggles [1] states that incontinence occurred in five out of thirty-nine cases at Rochester ; in three this serious affliction was permanent, and in one other it lasted for two years. Dr. Watson states that incontinence follows 3·5 per cent. of the perineal operations. On the other hand, this troublesome sequela rarely or never follows the suprapubic operation, for the operator working within the fibrous sheath of pelvic fascia need never trespass on the region of the sphincters and their nerves.

(6) *Rectal Injury.* The rectum has been occasionally injured during the perineal operation, and a troublesome recto-urethral fistula has not uncommonly resulted. Dr. Watson states that it has occurred in 2·7 per cent. of the cases. There is practically no danger of this accident with the suprapubic method, for the finger of the surgeon is kept well away from the rectum by the posterior wall of the strong fibrous sheath of the prostate. With dense and adherent prostates it is, however, possible to tear through this sheath and injure the rectum, but this must be a very rare accident, whereas Belfield states that perineal or rectal fistula occurred in 8 per cent. of 2000 perineal prostatectomies. [2]

(7) *Drainage.* This is a little freer with the perineal operation if the removal is complete, and certainly as regards the wound it is better ; it is a disadvantage, however, to have to pass a tube on to the bladder base, where it induces more pain, than the suprapubic tube properly inserted. Moreover, the patient cannot sit up so comfortably, and the sitting-up posture is of value in avoiding pulmonary complications.

(8) *The Duration of Anæsthesia.* A shorter anæsthesia is required for the suprapubic operation, and therefore the complications arising from the anæsthetic are less likely to follow it. Wiener [3] records eleven suprapubic prostatectomies performed under nitrous oxide anæsthesia, and all the patients recovered.

The lithotomy position is not a good one for a prolonged anæsthetic, especially in elderly men with rigid chests. It is, however, possible to perform both the perineal and the suprapubic operations under spinal anæsthesia [4] and the suprapubic operation has been frequently and very successfully performed under Stovaine in England during the last few years.

(9) *Permanent Urinary Fistula* should be very rare after both the perineal and the suprapubic operations, and there is little difference in the time taken for the wounds to close if the enucleation has been complete, although the perineal fistula closes a little earlier as a rule.

(10) *The Loss of Sexual Power and Sterility.* This is more common after the suprapubic operation than after a perineal one performed by Young's method. It should be remembered, however, that the impotence is not uncommon before the operation, and that the loss of sexual power is immaterial in the majority of cases, although it may be a serious matter in the few comparatively young men. Further, the sexual power is preserved in some cases after the suprapubic operation.

(11) Epididymitis is more common after the perineal operation.

[1] *Ann. of Surg.*, 1905, vol. xli, p. 559.
[2] *Ibid.*, January 1907, p. 101.   [3] *Ibid.*, vol. xli, p. 541.
[4] Young, *Journ. Amer. Med. Assoc.*, Feb. 4, 1905.

(12) *The Comparative Mortality.* It is difficult to arrive at any reliable conclusion upon this subject, for some surgeons select their cases; others, properly regardless of their statistics, do not refuse an operation if there seems to be a reasonable chance of affording relief to the patient. Mr. Freyer records twenty-two deaths in 312 suprapubic operations, a mortality of about 7 per cent. Young lost four of his 74 cases of perineal prostatectomy, a mortality of 5·4 per cent. It can be safely stated that in skilled hands the mortality of either of these operations should not be more than 10 per cent., and is likely to be somewhere between 5 and 10 per cent.

(13) Pelvic cellulitis is a little more common after the suprapubic operation, because of the better drainage of the cellular tissues provided by the dependent perineal incision.

(14) The suprapubic operation is not suitable for the comparatively rare cases of contracted bladder with non-distensible walls. In conclusion it may be stated that the suprapubic operation is the most suitable for critical cases, demanding a short operation with little shock and little anæsthetic; it is also to be recommended when the prostate is greatly enlarged, and when there are intravesical projections. When large stones or sacculi are present or a need for thorough examination of the interior of the bladder exists, the suprapubic route is the best. The perineal operation is more suitable for the removal of small hard enlargements, and for comparatively young men, to whom the sexual power is known to be of importance. It is not easy to perform in fat and bulky patients.

The future will almost certainly show the results of the suprapubic method to be at least a little better than those of the perineal operation. The one operation should be the complement of the other, and neither of them should be exclusively adopted for all sorts and conditions of a variable disease.

PARTIAL PROSTATECTOMY

We owe our knowledge of what this operation can do to the late Mr. McGill, of Leeds.[1] The following propositions are taken from his paper: (i) Prostatic enlargements which give rise to symptoms are intravesical, not rectal. Thus prostates of immense size which project towards the rectum cause no urinary trouble, while severe symptoms may supervene when the prostate on rectal examination is apparently of normal dimensions. (ii) There are many varieties of the intravesical growth. We find (1) a projecting middle lobe—pedunculated or sessile, (2) a middle lobe with lateral lobes forming three distinct projections, (3) the lateral lobes alone, (4) a pedunculated growth springing from a lateral lobe, and (5) "a uniform circular projection surrounding the internal orifice of the urethra." This variety, described by Brodie, is not infrequent, it surrounds the urethra like a collar, and projects for a variable distance into the bladder. (iii) In many cases self-catheterism is the only treat-

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[1] *Brit. Med. Journ.*, October 19, 1889.

Much information will be found in the following papers: Watson, *Ann. of Surg.*, 1889, pp. 1–27; Belfield, *Amer. Journ. Med. Sci.*, November 1890; Moullin, *Brit. Med. Journ.*, 1892, vol. i, pp. 1185, 1250, 1294; White, *Ann. of Surg.*, 1893, p. 152; Woolsey, *Journ. Cut. and Gen. Urin. Dis.*, July and August 1895; Watson, *Ann. of Surg.*, 1904, vol. xxxix, p. 833; Young, *ibid.*, 1905, vol. xli, p. 549; Wiener, *ibid.*, p. 541; Cunningham, *ibid.*, p. 590; Mansell Moullin, *Enlargement of the Prostate*, 1904; Freyer, 1906; Cuthbert Wallace, *Trans. Path. Soc.*, 1905, vol. lvi, Part I., and *Practitioner*, September 1905.

ment required. (iv) That when this fails, or is unavailable, more radical measures are necessary. (v) That this treatment, to be effectual, should (1) for a time thoroughly drain the bladder ; (2) permanently remove the cause of the obstruction. (vi) That the suprapubic route is preferable to the perineal for prostatectomy. Most surgeons will agree with this ; the question is alluded to at p. 691, and again below. This operation was short-lived, as it was laid aside for double castration, which at first seemed to be much less severe, but for a variety of reasons orchidectomy and allied procedures have given way to total suprapubic and perineal prostatectomy, which are now safer as well as more successful than either partial prostatectomy or castration. Partial prostatectomy had a mortality of 15 to 20 per cent., and Watson gives that of double castration as about 16 per cent. in these decrepit old men.

Secondary operations have often had to be undertaken after these procedures. For these reasons partial prostatectomy will not be described here. For an account of Fuller's method of partial prostatectomy combined with perineal drainage, *see* p. 709.

SUPRAPUBIC PROSTATECTOMY. TOTAL ENUCLEATION OF THE PROSTATE

Although the late Mr. McGill,[1] of Leeds, certainly removed large portions of the prostate bit by bit, and although the removal may have been complete in one or two cases, there is little doubt that the credit of introducing and perfecting the operation of total enucleation of the prostate *en masse* belongs to Mr. Freyer, who first showed that this was a feasible and rational surgical procedure.[2]

Partial prostatectomy, however extensive, was a very different thing from complete prostatectomy as now performed, and it was not attended with sufficient success to justify its general adoption. It was, in fact, almost completely abandoned for other measures, such as castration and vasectomy, which held their sway for a time, but have been generally discarded now.

For much of the following description of the operation I am indebted to Mr. Freyer's instructive work upon this subject.[3]

Preparation. If possible, the patient should be kept at rest for two or three days before the operation, the bowels should be opened daily, and an enema given early on the morning of the operation, so that the rectum may be quite empty. Any bronchitis that may be present should be attended to, or in some cases which do not call urgently for relief, the operation should be delayed until the pulmonary symptoms have abated.

In cases of cystitis, the bladder should, if practicable, be washed out once every day with a solution of silver nitrate $\frac{1}{5000}$, followed by boracic lotion toward the end of the irrigation. If cystitis be absent, lavage is neither necessary nor wise.

For cystitis, certain drugs may be given with the object of lessening the alkalinity of the urine, and of making the interior of the bladder less septic.

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[1] *Brit. Med. Journ.*, October 19, 1889. Dr. Fuller (*loc. infra cit.*) also removed most of the prostate suprapubically (*see* p. 680).

[2] *Ibid.*, July 20, 1901.

[3] *Enlargement of the Prostate*, 3rd ed., 1906.

Urotropine gr. xv, helmitol gr. x, or cystopurin, may be given in water twice a day. Acid sodium phosphate gr. x, with tincture of hyoscyamus ℳ xxx, may be added with advantage. The pubis is shaved, and the parts cleansed and painted with tincture of iodine.

After all the preparations have been completed the patient is anæsthetised.

Operation. The bladder is thoroughly washed out through a large-sized catheter, and then distended with boracic lotion. The catheter is left in and plugged with the nozzle of a bladder syringe. The syringe is full so that the bladder may be further distended, if there is any difficulty in finding it after making the incision. The surgeon stands on the right
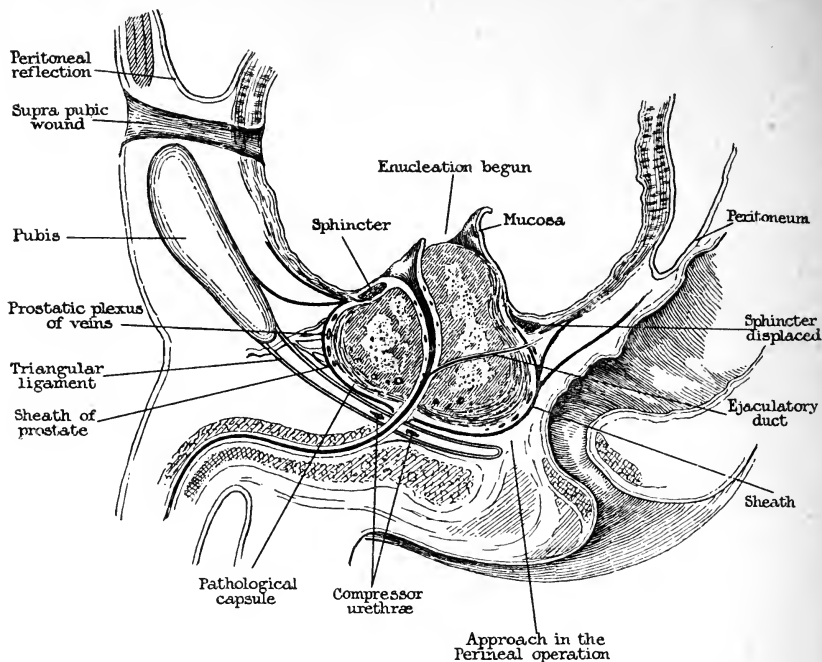
FIG. 283. The anatomy of the prostate. Suprapubic enucleation, and the line of approach in perineal prostatectomy. The direction of most of the fibres of the pathological capsule is transversely circular. The relations of the capsule, sheath, and prostate are shown. The vesical mucosa which covers and is separated from the prostate falls down and forms a funnel which joins the remains of the lower part of the prostatic urethra, after the gland has been enucleated.

of the patient. His right hand is gloved. A vertical median incision three inches long is made with its lower extremity at the pubis. The rectus sheath is opened, the muscular fibres separated, and any hæmorrhage arrested.

With the left index finger inserted at the lower end of the wound the prevesical fat is displaced upwards, carrying with it the peritoneum out of harm's way, and leaving the bladder exposed.

A bloodless spot is selected and the knife plunged into the bladder; as it is withdrawn the incision is enlarged downwards, so that it is about an inch long. The wound is enlarged by stretching with two fingers, if this becomes necessary later on. This has the advantage of avoiding any increase of hæmorrhage.

The left forefinger is introduced as the knife is withdrawn. As

some of the water escapes, the vesical orifice and the whole of the interior of the bladder are carefully and rapidly examined, so that no calculus or stone-bearing diverticulum may be overlooked. In one of my cases, I removed a large oval stone from behind the prostate, and another with much difficulty from a narrow-necked pouch which had herniated from the left lateral wall high up (p. 689). Any calculi present are at once removed with forceps or scoop, and the right forefinger is introduced into the rectum to push the prostate forwards and steady it. I often use two fingers to get a better grip.
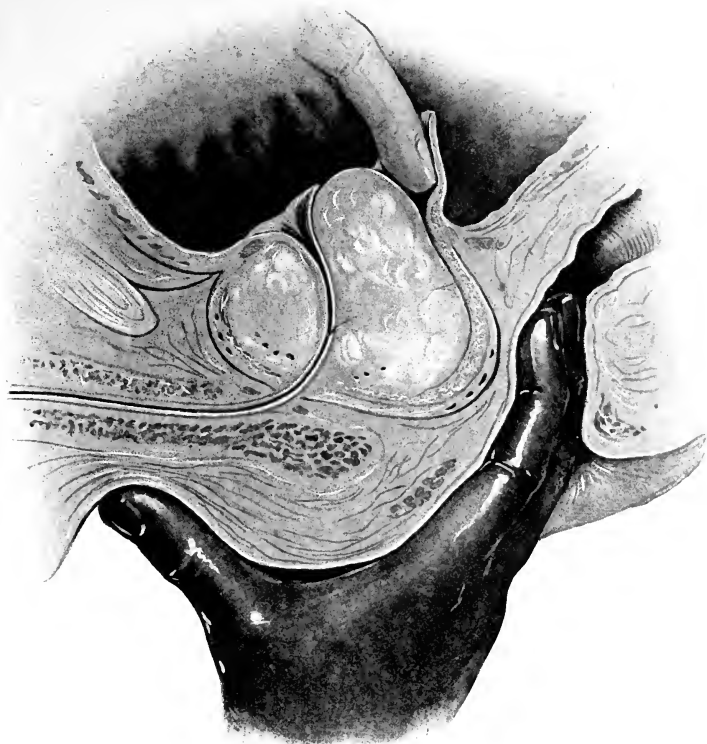
Fig. 284. Suprapubic enucleation of the prostate. The figure shows how the prostate is supported by two fingers and the thumb of the right hand, while the left forefinger enucleates the gland.

Now the surgeon uses the nail of the left forefinger for tearing through the mucous membrane over the prominence of the median or lateral vesical projection, so that he may not go too deeply and thus miss the proper layer for enucleation, for the prostate is covered only by thin mucosa on its vesical surface. It is very important to find the proper layer for the separation, and not to trespass upon the fibrous sheath with its venous plexus. If the first incision is carried too deeply true enucleation becomes impossible, and the difficulties and dangers of the operation are greatly increased, hæmorrhage is more profuse, much valuable time is wasted, and the removal is apt to be incomplete. Moreover, stricture is far more likely to develop.

During the enucleation the prostate is fixed between the rectal and

vesical fingers, the triangular ligament and the pubis. An assistant's finger in the rectum is not so valuable, for the operator cannot direct it so well, nor can he get the same control over the prostate. The combined action and sense of touch of the operator's own fingers are far more useful. The separation is carried on behind, at the sides and in front of the prostate, the finger being always kept close to the prostate and between the pathological capsule and the fibrous and vascular sheath of pelvic fascia, until the gland is free, except below where the urethra attaches it to the triangular ligament. The tip of the finger is now bent and gently separates the urethra from within the apex of the prostate all round as far as possible, the catheter serving as a useful guide. Then the finger behind the prostate and urethra hooks the prostate upwards and forwards, with the result that the urethra snaps at or above the insertion of the ejaculatory ducts ; above this point the tube is more closely attached to the prostate, and comes away with it. Mr. Freyer states that the insertions of the ejaculatory ducts are often preserved and remain attached to the lower part of the prostatic urethra, which is firmly fixed to the triangular ligament. At the end of the manœuvre which has been just described, and aided by the finger in the rectum, the prostate shoots up into the bladder.

Before the finger is removed from the rectum the fibrous walls of the cavity which contained the prostate are bimanually compressed, so as to diminish hæmorrhage and the size of the space that is left to heal. The loose lower parts of the vesical wall soon fall down into and line this cavity and unite with the upper end of the urethra. When the finger is withdrawn from the rectum the nurse holds the upper end of the glove and slips it off, and the surgeon rinses his hand in *lotion*. The prostate is withdrawn by strong long-shanked toothed forceps, held in the right hand and guided by the left forefinger in the bladder. The forceps compress the gland sufficiently to allow the removal through a comparatively small vesical incision. The lateral lobes often separate in front displaying the conical and dilated upper part of the urethra.

After the removal of the prostate, the bladder is thoroughly washed out through the catheter, which is still in. Hot boracic lotion (110° Fahr.) is used for this purpose. As soon as the clots have come away the irrigation is left off. In a few cases bits of prostatic tissue and clots have been left behind and have formed the nuclei of stones. A large smooth rubber tube ($\frac{7}{8}$ inch diameter) is inserted and sewn to the skin so that it projects for only about one inch into the cavity of the bladder, so as not to irritate the bladder base. It also projects an inch outside the skin. The vesical part of the tube is fenestrated, and the other end is sewn to the skin. A wick of gauze is passed below the tube to drain the prevesical space in case any leakage should occur in the first twenty-four hours. But as the bladder contracts the tube is firmly gripped and fits snugly. The upper part of the parietal wound is closed by interrupted salmon-gut sutures, which pass deeply and approximate the muscles and fasciæ, so that a ventral hernia may be prevented. No buried sutures are used. A piece of thin rubber tubing is tied to the projecting outer end of the tube to conduct the urine away and keep the patient dry during the first three days. The wound is covered with cyanide gauze, a thin layer of cotton wool and much cellulose wadding, which ensheath the back and sides as well as the front of the pelvis. A many-tailed bandage is used to keep the dressings in position.

The After-treatment. This is almost as important as the operation, and much depends upon the care and thought with which it is carried out. Free drainage is essential for success, and any failure of it may induce pain and hæmorrhage from distension, and cystitis, cellulitis, or renal complications may develop.

Irrigation should be carried out once daily through the suprapubic drainage-tube, the thin rubber tubing being detached for the purpose, a glass tube attached to an irrigating can being passed through the rubber tube and well into the bladder ; the fluid returns freely through the drainage tube, the patient being turned on his side.

Very little hydrostatic pressure is either advisable or comforable at first, the can or funnel being only about six inches above the level of the abdomen ; distension is painful and apt to cause hæmorrhage.

Warm boracic lotion is the best for general use, but when cystitis develops or, rather, pre-exists, $\frac{1}{2000}$ of nitrate of silver solution should be used, and followed by the boracic lotion.

The patient should be kept still during the first twenty-four hours, but as soon as the shock is over he must be propped well up, and made to lie alternately upon his sides and back, so that pulmonary complications may be avoided. The outer dressings should be changed whenever they get wet, so that the skin may not get sore, or the patient uncomfortable. Shock should be treated as already described, p. 8. Hæmorrhage by subcutaneous injection of pituitrin and free drainage of the bladder, and raising the foot of the bed. Axillary infusion, a pint in each axilla, is valuable, and in grave cases intravenous infusion is strongly indicated. This is best done by a transverse incision across the internal saphena, for the smaller veins are empty and difficult to find. I saved a feeble old man in this way ; when he appeared at the point of death three pints of saline solution were quickly run in. Pain should be relieved by morphia, unless the kidneys are very gravely affected. Threatening uræmia should be met by ingestion of abundance of fluid, and by infusion of saline solution if fluid is not retained by mouth or rectum. The bowels are kept open daily after the second day. The drainage-tube can be safely removed on the fourth day, there being no fear of extravasation into the pelvic cellular tissues. Irrigation is then carried out by introducing the glass tube through the sinus as long as this is practicable, and then by hydro-static pressure through a catheter inserted through the urethra ; this will not become necessary until about the ninth day. It is not necessary to tie the catheter in, with the idea of preventing a stricture. Its introduction and its continued presence only serve to irritate the urethra and the healing part without any compensating advantage. The urine should begin to come away through the urethra after about ten to fifteen days, and should be voided entirely along the natural passage after about three weeks or a month. After the suprapubic drainage-tube has been left out certain drainage apparatus such as those of Irvine or White may be found useful to keep the patient dry, but the wound heals better without any of these and the patient is freer to move about. He is allowed to get up a little on the fourth day. This enables the bowels to be opened with greater comfort and efficiency and it also tends to prevent pulmonary complications and maintains the muscular tone.

The two following cases illustrate some of the points in the operation. The second one is unusual in the amount of bleeding in a feeble old man and in the wonderful response to intravenous infusion.

CASE 1. *Prostatectomy. Four stones in Bladder—Recovery.* Mr. A., aged 73, is a short, very stout, but otherwise fairly healthy man. He has no cough, although he had an attack of acute laryngitis about three years ago. About twenty-five years ago he had retention of urine, which was thought to be due to a urethral calculus ; but none was ever seen. For the last five years he has had some difficulty with micturition, and this has increased a good deal during the last two years. There has been difficulty in starting and in completely emptying the bladder. About five weeks ago he had an attack of cystitis and, medicinal treatment failing, Dr. John Robertson used a catheter for the first time, and found residual urine, about four ounces. He washed the bladder out daily for a while and there was some improvement, but lately the symptoms have got worse again and there is a good deal of pain, rectal tenesmus, insomnia, and pus in the urine in spite of the washing out. The pain is very severe just before and at the end of micturition, and it comes on in spasms about every quarter of an hour and sometimes oftener. The patient rushes to pass his water with such violent straining that the bowels frequently open at the same time, and internal piles come down, bleed and become very painful. The patient cannot sleep or rest in bed, and spends most of the night sitting bolt upright in a chair. On rectal examination the prostate is hard, but movable and enlarged. A No. 9 catheter passed with ease and caused only a little bleeding once. A sound used by me on March 14, 1912, passed easily, but I was unable to feel any stone, although there might be one behind the enlarged middle lobe of the prostate. During the washing out Dr. Robertson had noticed that the bladder was small. It rarely could take more than about 5 or 6 oz. Prostatectomy was advised. Lately he has been taking tincture of hyoscyamus ♏xxx and urotropine gr. x three times a day ; but in view of the alkalinity and ammoniacal smell of the urine, I suggested giving him

Acid. Sod. Phos.	.	.	.	.	.	.	.	gr. xv
Tinc. Hyoscy.	.	.	.	.	.	.	.	♏ xxx
Inf. Aur.	.	.	.	.	.	.	.	ʒij
Water to the ounce								

Three times a day.

This brought an immediate improvement, the urine getting less offensive, with much less pus. Micturition became less frequent and painful. On the 18th, on passing a catheter, there was a good deal of residual urine, which was not foul, and the patient said that he felt much better ; but he still had great frequency of micturition with a good deal of straining. He was washed out with $\frac{1}{4000}$ bicyanide of mercury on the 18th, and again in the evening of that day. There was then just under 2 oz. of residual urine, which was clear. Every evening he had a suppository of morphia to give him sleep and to allay the tenesmus and straining. A purgative was given on the evening of the 18th, and an enema the next morning. An injection of morphia gr. $\frac{1}{4}$ and atropine gr. $\frac{1}{100}$ was given an hour before the operation.

Operation on March 19, 1912. Chloroform was given and the patient took it very well, although he got rather wheezy. Dr. Robertson helped. Although the patient was asked to pass water immediately before the operation, 8 oz. of nearly clear urine were drawn off on the operation table. The bladder was washed out thoroughly and then about 15 oz. of water were introduced into it. A long median incision was made above the pubes. The fibres of the rectus were separated, the peritoneum pushed up and the bladder opened. Four small stones were found behind an enlarged prostate, which bulged into the bladder all round the urethral orifice. These were removed with a scoop and the bladder bled where they were lying. There was an enormous pedunculated, pear-like, median piece of the prostate, which clearly acted as a flap over the rather dilated urethral orifice. The left index finger was used to tear through the mucous membrane over the right side of the vesical projection until the prostate began to shell out easily. Then the finger was swept backwards and to the right behind the middle lobe. Meanwhile the right forefinger (the right hand being gloved) was supporting the prostate from the rectum. The prostate shelled out with the greatest ease and was withdrawn out of its sheath into the bladder by means of the left index finger. As the man was very fat the surface wound had been made large so that the whole hand could be introduced as far as the anterior wall of the bladder, and the left index and middle fingers were introduced into the bladder, in order to enable me to get behind the middle lobe properly. Then the right finger was removed from the rectum, the glove slipped off, and forceps were used to withdraw the prostate entire. No pouch could be found in the bladder and no additional stone. There was very little

bleeding. The bladder was washed out thoroughly, and a large rubber tube containing a side hole near the end was introduced into the bladder and sewn to the edges of the wound. Four mass salmon-gut sutures were then used to close two-thirds of the wound, and two wicks of gauze were passed into the connective tissues, one above and one below the tube. The actual operation lasted about fifteen minutes. The patient was not collapsed at the end of it. He was allowed to sit up to have his bowels open on the fourth day, and afterwards was up in an armchair by the fire every day for tea, and soon began to walk about the room. The tube was removed on the fourth day. Irrigation was carried on for nine days, and the cystitis rapidly cleared up. The medicine given before the operation was continued. The wound soon healed, and voluntary micturition began on the twelfth day. Irrigation was continued through the urethra until the suprapubic sinus closed completely. The patient went home a month after the operation, and has continued in very good health ever since, having no difficulty of any kind in passing or retaining his water. At the same time I had under my care two other men aged 77 and 79 who had undergone the same operation, and they did very well.

CASE 2. *Prostatectomy. Large Stone in the Bladder. Hæmorrhage—Intravenous Infusion—Recovery.* Mr. J. C., aged 65, indigo planter. Patient of Dr. Palmer, Ramsgate.

The patient is an Anglo-Indian. He looks much older than his years and is very thin. He has had cystitis and difficulty with micturition for many years. These symptoms have got much worse of late, and the urine has become very offensive. He came home to have an operation performed. When the patient arrived at Ramsgate he was very ill. He had had a miserable journey from India, having to pass water every few minutes, and the urine was very offensive. Since then Dr. Palmer has washed him out every day and the cystitis has improved, but the patient was very feeble and his general health was not improving, therefore it was not thought advisable to delay the operation. I saw the patient on September 14, 1913, and thought it probable from the symptoms that he had a stone in the bladder as well as enlargement of the prostate. He had had complete retention and had been entirely dependent upon a catheter of late.

Operation on September 14, 1913, at 2 P.M. Dr. Halstead gave the anæsthetic and Dr. Palmer assisted. The bladder was washed out, and a stone was felt during the process. A suprapubic wound was made. A large stone was felt in the bladder. It was four inches long, two inches broad and one inch thick. It was rough on the surface, having spikes in places. It was very difficult to remove, even when the incision into the bladder had been enlarged. When it had been removed the prostate was found to be enlarged, but not so greatly as had been supposed, and it was debated whether the prostatectomy should not be deferred on account of the patient's feeble condition, but he himself had expressed a strong desire for a radical operation or nothing. I therefore went on and removed the prostate, which was about three times the natural size, in a few minutes quite easily in one piece. There was a good deal of bleeding afterwards, although the cavity was compressed bimanually. A large tube was inserted in the bladder. Directly the patient was returned to bed he was infused into the armpits, two pints of saline being given, and shock was treated. He responded a little, but at 4.30 P.M. he was very much worse. The pulse was getting imperceptible. He had not absorbed much of the fluid into his armpits, and I therefore immediately infused him into the left saphena vein, introducing three pints. I at first tried to find the right median basilic vein, but could not do so. I also tried to introduce fluid into the dorsal vein of the hand without effect. There was no bleeding of either wound. I then cut across the front of the thigh, making a large incision, but this wound did not bleed. The saphena vein was quite empty. The patient was very restless, but quite unable to move his legs although he was clearly suffering pain. He rallied as the saline ran in, became quite calm and rational, and went to sleep again. His pulse became perceptible and slowed down to 120. He rapidly revived and was much better in the evening. He had a certain amount of sloughing of the wound. The tube was removed on the third day, and the bladder was washed out daily. The patient made a very good recovery and was in excellent health and able to walk three or four miles three months later. He was quite well in January 1915.

OPERATION IN TWO STAGES

In certain cases it is wiser and safer to perform the operation in two stages. It is very rarely wise to perform prostatectomy in the presence of complete retention ; it is far safer to deal with the retention first, either by catheter, suprapubic puncture, or suprapubic cystotomy. In this way the risk of suppression of urine, ascending nephritis and other complications are diminished, for the kidneys are considerably damaged, congested, and often inflamed as a direct result of the retention. Then the shock of a severe operation is too great for the maimed kidneys, which may cease working. Similarly, when there is much cystitis, especially if the urine is scanty or there are signs of chronic uræmia in a feeble patient, perhaps with other visceral disease, such as chronic bronchitis, it is wise first to drain the bladder freely by suprapubic cystotomy, and to defer the prostatectomy until the kidneys and the general health are in a better condition. It is often remarkable to notice the rapid improvement following the preliminary drainage. Stones are found in the bladder in 20 per cent. of the cases of enlarged prostate coming to operation. As a rule, these are easily removed and scarcely add to the duration or danger of the operation, but when there is much delay, difficulty, or hæmorrhage associated with the removal of stones from the bladder or from a sacculus, it is wise to defer the prostatectomy to a later date.

When stones had to be removed at the time of prostatectomy Freyer found the mortality in 190 cases to be nearly double that of simple prostatectomy, but stones form chiefly in the late and bad cases with cystitis, so that the increase of mortality is only partly due to addition of lithotomy to prostatectomy. It is, I think, chiefly due to the more serious deterioration of the kidneys and general health.

Although there are advantages in performing the operation in two stages in selected cases, it should be realised that secondary prostatectomy is often more difficult, and it carries with it the dangers associated with an additional anæsthetic and an additional period of confinement, which is irksome and somewhat dangerous to an old man.

On p. 689 I have described a case demanding operation in two stages on account of a stone impacted in a sacculus. Mr. Freyer relates the following as a typical example of one of the few conditions under which it is advisable to divide the operation into two stages, so that the uræmic symptoms may pass off and the kidneys regain their full excreting powers before removing the prostate. Had the gland been removed without preliminary drainage in this case, the shock to the damaged kidneys would probably have induced total suppression of the urine.

"A patient, aged 66, consulted me on April 29, 1912, on the advice of Dr. T. M. Tibbetts, of Old Hill, Staffs, suffering from prostatic symptoms which had existed for twelve years, gradually increasing in intensity. For months previously he had had the catheter passed three times daily at a hydropathic institution, but latterly he did not employ the catheter. The bladder was greatly over-distended, the patient having to pass urine hourly by day and by night. During the previous three months he had suffered from extreme thirst, headache, bitter taste in the mouth, with gradual loss of energy and appetite—symptoms which indicated uræmic poisoning. I drew off 32 oz. of residual urine, colourless like water ; specific gravity 1005, and containing a trace of albumin. The prostate felt much enlarged, dilated, dense, and movable. Owing to the uræmic symptoms I decided to drain the bladder suprapubically before removing the prostate, so as to relieve the backward pressure on the kidneys and thus enable them to regain their functions.

"Assisted by Dr. Tibbetts, I performed suprapubic cystotomy on April 30, and

found that the prostate presented a tongue-shaped outgrowth in the bladder. The previous uræmic symptoms continued for some days and troublesome hiccough supervened ; but all these symptoms gradually subsided, so that on May 14, assisted by Dr. Tibbetts, I was able to complete the operation. The prostate, which was pear-shaped and weighed 3 oz., was easily enucleated. The suprapubic wound was completely closed on May 31, and on June 15 the patient went home in excellent health, able to retain and pass his urine as well as he ever did. On March 6, 1913, he wrote to me : " I never felt better in my life ; I have never since had any pain or inconvenience ; my urinary flow is perfect and my appetite splendid."

RESULTS OF SUPRAPUBIC PROSTATECTOMY

In 1911, Mr. Freyer, who has the greatest experience of this operation, reviewed the results of his first 800 cases, and in 1913 he reported 236 additional operations performed during 1911 and 1912. I venture to quote from his last paper.

" There were in connection with these 236 operations 11 deaths, or 4·66 per cent.

" Reviewing briefly my experience of this operation to the end of 1912, comprising 1036 cases, the patients varied in age from 49 to 90 years, with an average age of $69\frac{1}{4}$ years. There were amongst them 65 octogenarians and 11 bordering on this age, viz. 79 years. The prostates removed ranged from $\frac{1}{2}$ to 17 oz. in weight, the approximate average being $2\frac{3}{4}$ oz. Though the patients were, of course, mainly drawn from the British Isles, practically every nation and race on the face of the earth are here represented. The great majority had been dependent on the catheter for periods ranging from a few days to 24 years. Most of them were in bad health and many were apparently moribund when the operation was undertaken. Few of them were free from one or more grave complications, kidney affections resulting from backward pressure on those organs predominating. In the larger number existence was rendered so painful and miserable that they were prepared to face any risk from operation provided they could be assured that in case of survival they could dispense with the catheter.

" In connection with these 1036 operations there were 57 deaths, or $5\frac{1}{2}$ per cent., the remaining 979 cases, with the exception of one case, being completely successful. In only this one case has the patient failed to regain the power of voluntary micturition, and in this instance the bladder was quite flaccid and seems to have been completely paralysed by the extreme over-distension by the urine before the catheter was employed. With experience the mortality has gradually diminished from about 10 per cent. in the first 100 cases to a little over $4\frac{1}{2}$ per cent. in the last 400.

" The causes of death were : uræmia due to chronic kidney disease, 24 ; heart disease, 9 ; shock, 7 ; exhaustion, 3 ; septicæmia, 3 ; mania (hereditary in one case), 2 ; malignant disease of the liver, 2 ; bronchitis, 2 ; pneumonia, 1 ; heat-stroke, 1 ; pulmonary embolism, 1 ; cerebral hæmorrhage with paralysis, 1 ; and acute pancreatitis, 1. Though all these deaths are accepted in connection with the operation, in not more than half the number can the fatal result be attributed thereto, the remaining deaths being due to disease incident to old age and unconnected with the operation. Had the cases been selected the mortality would have been infinitesimal, but, as will have been gathered from the successful cases given in detail in my numerous papers which have appeared in the *Lancet* and *British Medical Journal* during the last 11 years, selection would have condemned a large proportion of them to a painful death

after prolonged suffering instead of the complete restoration to health that ensued after the operation.

" In 190 cases the prostatic disease was complicated by the presence of stone in the bladder, mostly of the phosphatic variety due to cystitis. The operation in these cases partook, of course, of a dual character—prostatectomy in addition to suprapubic lithotomy. Amongst these there were 16 deaths (all of which have been accepted as resulting from the prostatectomy part of the operation), or 8·42 per cent. Amongst the remaining 846 cases uncomplicated with stone, there were 41 deaths, or 4·84 per cent., so that the mortality amongst the former was nearly double that amongst the latter.

" One of the most satisfactory features of this operation is that the patients as a rule state, after the lapse of months or even years, that they feel from 10 to 20 years younger than before the operation. This remarkable rejuvenescence has so much impressed me that, apart from the physical pain and mental depression caused by the obstructive symptoms, I am persuaded that the enlarged gland pours into the system some internal secretion of a toxic or deleterious nature."

Mr. Freyer's experience of the operation is unrivalled, his dexterity great, and his results so very good, that the young surgeon is in danger of being led to believe the operation simple, easy, and almost devoid of danger, leading almost inevitably to a complete recovery and a perfect functional result.

It is my duty to warn him and to say that he will occasionally find the operation very difficult, and that he must be very careful to find the proper layer for separation, aiming not for marvellous speed, but for perfect work. Speed will come with time and experience. The mortality of the *average* surgeon is not, I think, likely to be much below 10 per cent. The after results are not always perfect, often there is a little frequency and uncertainty of micturition.

Sometimes cystitis, and occasionally a stone forms in the bladder. Very rarely a stricture develops. It has been said that such a thing is unknown, but I know of several instances, all following difficult removals of small prostates.

Sometimes the prostatic space is not quickly obliterated, but granulates and bleeds, and phosphatic deposits may form there. Such a case was referred to the writer, after the operating surgeon had diagnosed malignant disease. The sound struck a stone, the size of a walnut and very irregular, on the surface occupying the prostate space, whence it was dislodged suprapubically with considerable difficulty. The man, who was in great misery, made a complete recovery. Very rarely the power of the bladder or even its capacity may not be completely restored —especially when the operation has been too long deferred.

But when all is said, the results are unexpectedly and remarkably good, especially when pains are taken to acquire the peculiar skill required, and when patience is bestowed upon the after-treatment.

PERINEAL PROSTATECTOMY

Operation. This operation was strongly advocated and well described by Proust.[1] Albarran and others on the Continent warmly supported it. In America Young and others popularised the operation. It has never

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[1] Press *Med.*, October 1901.

been very popular in England owing to the earlier knowledge of the brilliant results of the suprapubic operation. Of late American and Continental surgeons have been more frequently adopting the suprapubic route.

The bladder having been washed out and the patient placed in the extreme lithotomy position, so that the perineum almost faces upwards, an incision is made as shown in Fig. 285. The one shaped like an inverted **V** is sufficient in most cases, and the angle may be avoided, and a semilunar wound made after the ancient plan adopted by Celsus for lithotomy. The central tendinous point of meeting of the perineal muscles is sought, and a transverse incision made through it separating the accelerator urinæ, and transverse perineal muscles from the sphincter ani insertion. This step is of great importance, and must be carefully observed, otherwise the rectum may be injured. The rectum is now carefully displaced backwards by blunt dissection, which is carried deep

Inverted Y incision
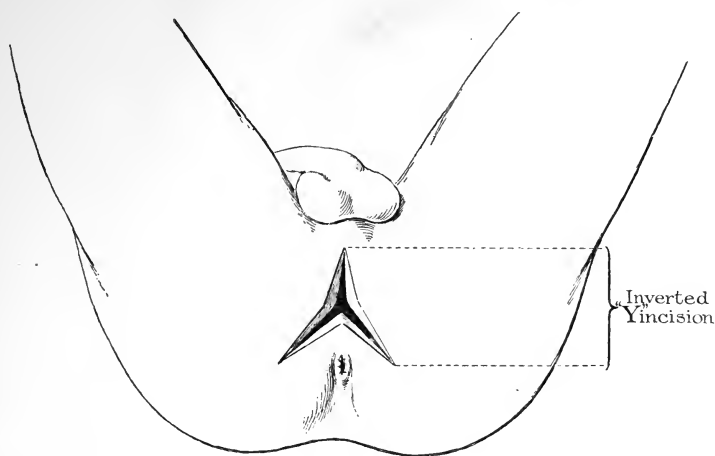
FIG. 285. Perineal prostatectomy. Inverted **Y**-shaped incision. (After Watson, *Ann. of Surg.*) An inverted **V** or a semilunar incision is generally sufficient.

enough to expose freely the posterior surface of the fibrous *sheath* of the prostate. The wound is well opened with retractors. A grooved staff is passed into the urethra, which is opened exactly in the middle line upon the staff well above the triangular ligament and through the apex of the prostate to avoid any possible injury of the compressor urethræ. The edges of the urethral incision are picked up and retracted with tissue forceps or sutures (*see* Fig. 286).

Young's tractor (or that of de Pezzer) is then passed through this opening well into the bladder; its blades are opened out. Traction is then made with the blades of the instrument directed laterally above the lateral lobes of the prostate (*see* Fig. 287). These and similar tractors are of great value in bringing the prostate downwards and backwards well into view. The finger, passed through the urethra, although sensitive, is not nearly so serviceable and is in the way, as well as needed for other purposes. Suprapubic pressure is rarely efficient, and traction through the rectum is dangerous. Care must be taken, especially towards the end of the enucleation, not to exercise too much force with tractors, lest the blades tear through the thin vesical mucosa, and bring

away the urethra and vesical outlet.[1] When the posterior surface of the prostatic sheath is displayed two lateral incisions are made through it, so as to expose the true capsule within (Fig. 288).

Young [2] uses these lateral incisions in order to avoid injuring the ejaculatory ducts which run between the two incisions.[3] The lateral lobes are then separately enucleated by blunt dissection with the finger, if possible, care being taken to preserve the urethra, and the mucous mem-

Levator ani

Sound in urethra

Sutures holding urethra open
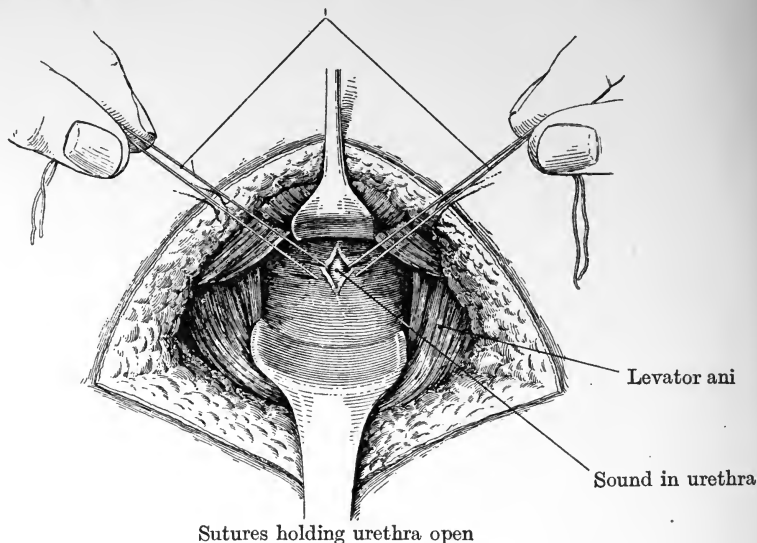
Fig. 286. Perineal prostatectomy. Opening the urethra at the apex of the prostate upon a grooved sound. The levatores ani are drawn backwards with the rectum by smooth retractors, and the transverse perineal muscles are drawn forwards with the accelerator urinæ, and the bulb of the corpus cavernosum. The posterior surface of the prostatic " sheath " is shown. (After Young, *Ann. of Surg.*)

brane of the bladder just below the blades of the tractor. When freely separated each lobe is withdrawn, if necessary, with the aid of forceps. The position of the tractor is then changed, so that one of its blades engages and brings down the median lobe into one of the lateral incisions in the
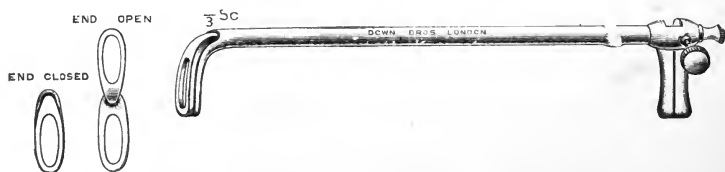
Fig. 287. Young's prostatic tractor. (*Ann. of Surg.*)

fibrous sheath. If this is not found to be practicable the finger may be used instead of the tractor. Dr. Young states that " in certain cases in which a fibrous median bar or lobe is impossible to remove by the technique described above (in which every effort has been directed to leave the ejaculatory bridge undisturbed), it may be necessary deliberately

[1] Watson, *loc. infra cit.*   [2] *Journ. Amer. Med. Assoc.*, October 24, 1903.
[3] Nicoll occasionally used similar incisions : *Lancet*, April 14, 1894.

to cut through the capsule covering the ejaculatory ducts, and thus expose and enucleate or excise the median prostatic enlargement." If a stone is present in the bladder, even a large one may be removed by " dividing the lateral wall of the urethra and dilating the vesical neck," and mere dilatation gives sufficient room in some cases. The bladder is washed out and a large drainage-tube inserted, so that one end is just within the bladder and the other is stitched to the skin. Dr. Young drains the bladder and carries out continuous irrigation through two catheters tied together, and introduced through the perineal incision.

Tractor

Lateral incisions through prostatic sheath
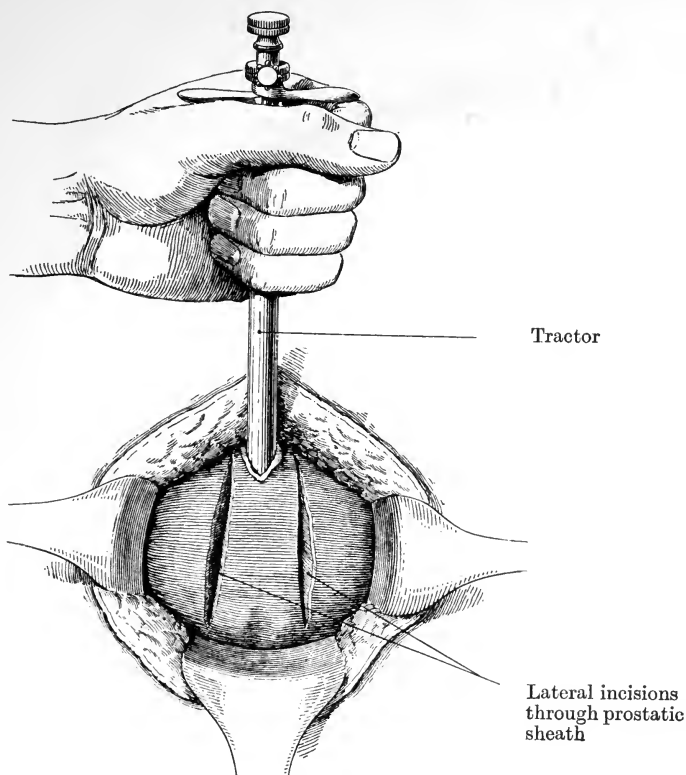
FIG. 288. Perineal prostatectomy. Tractor introduced, blades separated, traction made exposing posterior surface of the prostate. Incisions in the fibrous sheath on each side of ejaculatory ducts, exposing the true capsule of the prostate. (After Young, *Ann. of Surg.*)

Continuous irrigation is not necessary, but it is sufficient to irrigate once daily. The wound is lightly packed with gauze. The anterior wall of the rectum is examined and protected by suturing the separated edges of the levatores ani in front of it with catgut. Care must be taken not to pack any gauze against the rectal wall lest sloughing occur. The rubber tube may be left out after five days, and a sound should then be passed through the meatus into the bladder to ensure the patency of the urethra just in front of the perineal wound.[1]

Dr. Young maintains that it is quite possible to remove all the prostate in segments without damaging the ejaculatory ducts, and many of his

[1] Pilcher, *loc. infra cit.*

patients have preserved or regained their sexual power.[1] This, although immaterial in most cases, may be of great importance in some, especially in comparatively young men of between 40 and 60. Epididymitis is said to be far less common when the ejaculatory ducts are not divided; when their open ends are left in the deep wound, septic inflammation may travel along them to the epididymis.
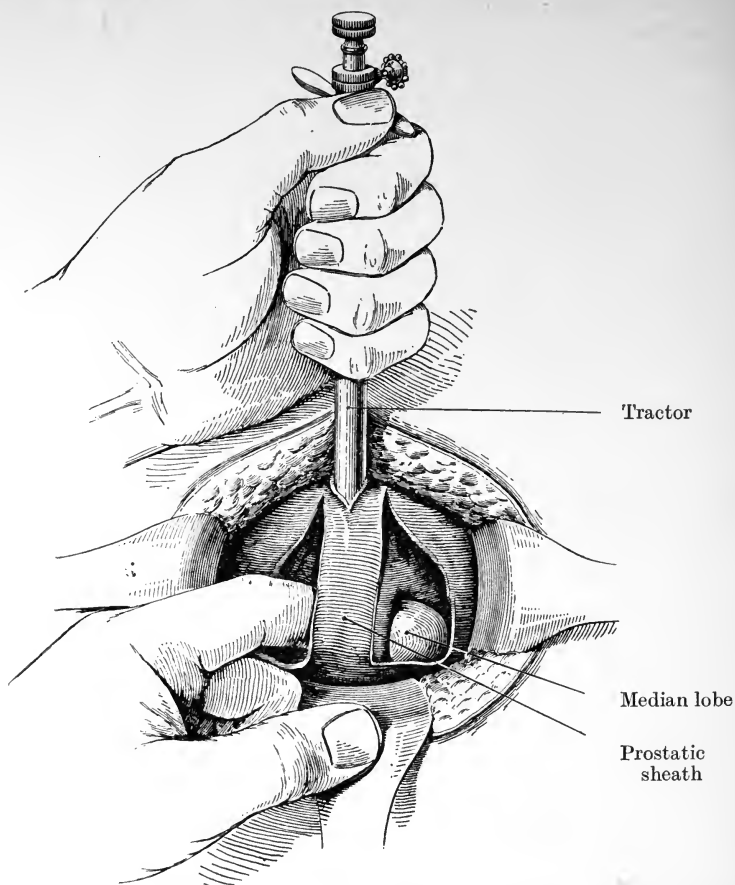
Fig. 289. Perineal prostatectomy. Showing the technique of delivery of middle lobe into cavity of left lateral lobe. (After Young, *Ann. of Surg.*)

Median Perineal Enucleation through the Urethra. The urethra is opened, as in median perineal cystotomy, and the prostate enucleated by means of the finger introduced into the prostatic urethra, the lateral walls of the urethra being torn through. The chief objections to this method are that the gland cannot be enucleated as a whole, and it may therefore be incomplete, a vesical projection being very apt to be missed in spite of careful suprapubic pressure. The room afforded is so small, and the depth at which the work must be done, make it difficult, and even impossible, with large hypertrophies. A perineal fistula or incontinence may persist. Goodfellow records 78 operations by this method

[1] *Ann. of Surg.*, vol. xli, p. 556.

with two deaths, and Murphy 51 with one death: Parker-Syms 33 with two deaths.[1]

Dr. Chetwood [2] strongly advocates perineal prostatectomy in two stages, not only when acute retention exists, but also in grave cases of cystitis, renal changes, and general debility, especially in advanced old age. He first performs a median perineal cystotomy, and about a fortnight later, and under more favourable circumstances, he removes the prostate through the median perineal incision and prostatic urethra.

Fuller's Operation. *Suprapubic Operation with Perineal Drainage.* This consists of a suprapubic enucleation of " hypertrophies " but not a total extirpation ; the suprapubic vesical wound is sutured, and the bladder drained through a median perineal incision. The bladder having been opened the extent of the prostatic enlargement and the site of this urethral opening determined, the subsequent steps are carried out as described by Dr. Fuller.[3]

" A pair of rough, serrated-edged scissors with a long handle grasped in the right hand are slipped along the left forefinger into the urethral opening, and are made to cut through the bladder wall in that region. The cut extends from the lower margin of the internal vesical opening of the urethra backward for an inch or an inch and a half. The blades of the scissors being rough and serrated, make an incision which bleeds but little. Then one of the forefingers, whichever the operator may find the more convenient, is slipped through the vesical hole made by the serrated scissors, while at the same time the fist of the other hand makes firm counter-pressure against the perineum. By means of this counter-pressure the prostatic growth is brought well within reach of the forefinger of the other hand, which is employed all the time in enucleating the obstruction *en masse*, or piece by piece, as the case may be. This enucleation should not be desisted in until all the lateral and median hypertrophies, as well as all hypertrophies along the line of the prostatic urethra, have been removed." Dr. Fuller states that owing to the small amount of bleeding he has always found it feasible to sew up the suprapubic incision as described below, and that he has never had trouble with secondary hæmorrhage. A perineal section is next made and a large-sized rubber tube passed through the perineal incision into the bladder. After this hot-water irrigation is employed for some time to stop oozing. Next, the suprapubic wound is closed by a deep layer of catgut sutures which include the bladder wall, and by a more superficial layer of silk-worm gut. The middle of the incision is not closed, but a deep provisional salmon-gut suture is inserted here, taking up the walls of the bladder and the abdomen. A drainage-tube is inserted, and when this is removed in four or five days the provisional suture is tightened up. Six cases of prostatectomy, five of these operated on by this suprapubic method, are given by Dr. Fuller ; all were successful.

Causes of Death after Operations for Enlargement of the Prostate. (1) Uræmia is by far the commonest ; (2) shock ; (3) hæmorrhage ; (4) cardiac failure ; (5) ascending suppurative nephritis ; (6) pelvic cellulitis, pulmonary complication, pneumonia, or bronchitis ; (7) mania and other forms of insanity ; (8) pulmonary embolism.

[1] Pilcher, *Ann. of Surg.*, 1905, vol. xlix, p. 566.
[2] *Ann. of Surg.*, 1906, vol. xliv, p. 563.
[3] *Journ. Art. and Gen. Urin. Dis.*, June 1895, p. 232.

Preliminary or Palliative Operations for Enlarged Prostate. Cystotomy may have to be performed for the relief of acute retention, intravesical hæmorrhage, severe cystitis, threatening uræmia, or for the removal of calculi. It is far better to adopt the suprapubic in preference to the perineal route, which is a long and troublesome one in these cases, for acute retention. Aspiration is not suitable except merely to relieve the patient while awaiting other and more satisfactory measures. Although aspiration may be followed by such a diminution of congestion of the prostate and urethra that a catheter can be passed after a few hours, this is not to be relied upon, for a repetition of the aspiration is very likely to become necessary again and again, with the result that some of the urine, which is usually infective, if not always foul, leaks into the pelvic cellular tissues with disastrous results.

It is, therefore, far better, when all attempts at catheterisation have failed, to perform either suprapubic cystotomy or suprapubic puncture with a trocar and cannula. In either case drainage must be established, and continued until urine passes naturally, or a catheter can be introduced through the urethra. Suprapubic cystotomy provides the best drainage, and therefore the best safeguard against renal complications and pelvic cellulitis, but suprapubic puncture is the easiest to perform in an emergency without proper help, and the fistula closes sooner if the natural passage becomes re-established. Care must be taken, however, not to remove the suprapubic catheter until its track is sealed off from the cellular tissues, so that extravasation may not occur. In most cases it is best to perform suprapubic cystotomy and to drain the bladder until cystitis, congestion, and any uræmic symptoms have subsided, and then to perform suprapubic prostatectomy, if there are no contra-indications.

PRIMARY MALIGNANT DISEASES OF THE PROSTATE

This is a comparatively rare cause of enlargement of the prostate, although it is not so uncommon as is generally believed ; and for this reason it is important to examine all prostates which are removed for supposed adenomatous enlargement. Carcinoma is by far the commonest malignant growth, and Holmes Green estimates that from 5 to 10 per cent. of the senile prostatic enlargements are carcinomatous. Freyer [1] states that 13·4 per cent. of his 1276 cases of enlargement were malignant, only one of these was sarcomatous. It occurs in men who are well advanced in years. The average age of 19 cases which were collected by Holmes Green was 68 years,[2] and of 100 cases collected by Kaufmann all were over 40, and 68 per cent. were between 50 and 70 years of age.[3] Sarcoma is much less common, and occurs in younger subjects.

The carcinomatous prostate differs from the adenomatous in being nearly always much harder, far more fixed and nodular upon the surface. It also gives rise to much more pain in the perineum, penis, sciatic region, and rectum. Bleeding is also more common, and occurs more frequently apart from retention and instrumentation. Later on the iliac and groin glands may be enlarged, the rectal wall invaded, and metastasis may become evident, especially in the bones. These may appear

[1] *Lancet,* December 13, 1913.
[2] *New York Med. Journ.,* October 24, 1903.
[3] Hawley, *Ann. of Surg.,* 1904, vol. xxxix, p. 893.

when the primary growth is comparatively small and removable, so that it is important to examine for them.

Operations. (*a*) *In late cases* either no operation is indicated, or palliative suprapubic cystotomy may become necessary for retention of urine, but as long as the obstruction can be overcome by means of a catheter, without much pain, no operation should be undertaken. After a suprapubic cystotomy or puncture a permanent drainage apparatus can be used.

(*b*) *In early cases.* Since Billroth's original case of perineal extirpation in 1859 many attempts have been made to perform radical operations for malignant disease of the prostate, but most of the attempts have been far too late, so that many have considered operative interference always unjustifiable. Recent results are more favourable, however. If the diagnosis is made soon, and before the disease has invaded the bladder or urethra, and in the absence of any signs of dissemination, the growth may be explored through the perineum ; and enucleated from within the fibrous sheath, if possible. If cystoscopy has not been practicable, it will be necessary to perform suprapubic cystotomy, in order to determine the freedom, or otherwise, of the bladder, before extirpation is attempted. In some cases it is quite impossible to pass the cystoscope through the hard and contracted prostatic urethra, but this difficulty usually arises in late cases, which are unsuitable for any radical operation.

To attempt to remove an adherent prostatic carcinoma is meddlesome surgery, and is to be heartily condemned. The only hope is in the early stage, when the diagnosis is, unfortunately, difficult.

Holmes Green and others have removed early carcinomatous prostates in mistake for so-called senile hypertrophy. In Dr. Green's case only one lobe of the gland was malignant. The patient recovered, and was well a year later, except for a small fæcal fistula, the result of injury of the rectum at the operation.

Oraison reports " 23 cases from the French clinics in which perineal prostatectomy was done. In 10 of these (43 per cent.) cure has remained permanent after more than four years. In three only were there recurrences. Six others recovered, but were lost sight of ; the remaining four died from the operation." [1]

Mr. Freyer [2] writes as follows :

" I am of opinion that a prostate attacked by malignant disease previous to its undergoing adenomatous enlargement is rarely, if ever, capable of enucleation suprapubically by my method of dealing with hypertrophy of the prostate, or of being effectually removed by any other method, for the simple fact that by the time the symptoms declare themselves the disease has already passed through the capsule of the gland and invaded the adjacent structures.

" When, however, cancer supervenes on, or is due to degeneracy in, a previously enlarged adenomatous prostate, as we now know very frequently happens, and the patient comes under observation whilst the prostate is still movable and the adjacent structures uninvolved— that is to say, whilst the malignant disease is still confined within the capsule of the gland—the prostate can, and should be, enucleated, my experience of operation under such conditions being most favourable, as the details of the cases that I shall presently place before you will show.

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[1] Hawley, *loc. supra cit.*   [2] *Loc. supra cit.*

It will sometimes be impossible to give a definite diagnosis of malignancy in such cases before the removal of the prostate, though the presence of hard nodules in the gland, combined with the rapid progress of the symptoms, will arouse strong suspicions in the surgeon's mind, suspicions which, I need scarcely add, should be communicated to the patient's relatives before the operation is undertaken."

Mr. Freyer gives details of eight cases successfully treated by suprapubic enucleation, some of them having survived nearly ten years without recurrence. Speaking of the *results of operation* he says :

" **Results of Operation.** Did time permit I could give details of other cases of the same description. Those already described, however, amply prove that if we can enucleate the prostate entire whilst the malignant disease is still confined within its true capsule, we can with every confidence look forward to a perfect cure ; and the operation is attended by no more danger than that attached to the enucleation of a simple hypertrophied growth of the organ.

" I could give you details of other cases in which, I regret, the results were not so satisfactory, the malignant disease recurring locally in the adjacent structures, after more or less lengthened periods, leading eventually to contraction of the urethra at the neck of the bladder, necessitating the employment of the catheter or the establishment of a permanent suprapubic fistula. In these cases the disease had evidently invaded the surrounding tissues before the enucleation of the prostate. If the prostate can be enucleated entire, even when unusually adherent to the surrounding tissues, I confess that I feel a strong inclination to accomplish this, and have never regretted doing so. Even should the disease recur, it is a great consideration for the patient to be able in the interval to urinate normally, thus deferring for months or even years the establishment of a permanent fistula, which can always be had recourse to when necessary."

" **Malignant Degeneration of Benign Prostatic Growths.** I have in my remarks hitherto dealt only with cases of cancer of the prostate diagnosed as such, or in all probability as such, before operation. It is, however, held by many writers that a very considerable proportion of enlarged prostates regarded as benign adenomata at the time of operation turn out on pathological examination to be of a cancerous nature. This view was, I believe, first propounded by two eminent French authorities—Albarran and Halle. These gentlemen having examined microscopically a series of 100 prostates, which had all the appearance of being benign, found amongst them 14 cancers, with all the intermediate histological appearances between the pure adenoma and the epithelioma, thus giving rise to the view that the adenomatous transformation of the prostate in advanced age is, in a number of instances, the primary stage of a malignant degeneration. Now, I have had no systematic pathological examination made of what I regarded as benign enlargements of the prostate, considering this as unnecessary except in cases where there was some doubt in my mind as to the nature of the growth. But if the tenets of Albarran and Halle be applied to the series of more than 1100 supposed benign prostates removed by me in the past 12 years it would indicate that, unknown to myself, I had removed amongst these no less than some 150 carcinomatous prostates. Well, I cannot trace amongst the subjects of the whole of my operations for supposed benign growths of the prostate more than half a dozen instances in which cancer subsequently afflicted these patients. The cancer in these cases supervened at lengthened periods after the

operation in organs distant from its site, and the proportion can scarcely be regarded as greater than would normally occur in patients the average age of whom at the time of operation was 69 years."

It is probable that some pathologists have accepted insufficient evidence of malignant changes in an adenomatous prostate, for the chronic clinical history of patients suffering from adenomatous enlargement does not suggest anything like such a frequent malignant termination.

PROSTATIC ABSCESS

Prostatic abscess may be either chronic, tuberculous, or acute gonorrhoeal, septic or pyæmic. Tuberculous abscess often occurs in the course of tuberculous disease of other parts of the genito-urinary tract. Acute abscess generally gives rise to high temperature often with rigors, and, as a rule, a great deal of straining and difficulty in passing water, with acute retention sometimes, pain in the perineum and rectal tenesmus ; but occasionally there are no local signs but only high fever with rigors.

Treatment. An acute abscess often opens spontaneously into the urethra, or it may be perforated by the catheter, which is introduced for retention of the urine. In other cases it opens into the rectum, but in some it burrows back into the ischio-rectal fossa and issues by the side of the anus. The perineal route is the best to choose for opening and draining the abscess, and should be adopted, if possible, before the pus has burrowed about or has given rise to pyæmia. The abscess drains but poorly along the urethra, and its discharge in this direction may be followed in some cases by cystitis, urethritis, or troublesome urinary fistulæ. When the abscess has burst into the rectum it generally drains well, but sometimes the opening closes or narrows and has to be dilated under an anæsthetic.

Operation. The patient is placed in a lithotomy position, and a finger is introduced into the rectum and rests upon the apex of the prostate. A knife is introduced into the perineum one inch in front of the anus with its back towards the latter, and gradually pushed upwards towards the prostate guided by the finger in the rectum until it is felt to enter the abscess cavity in front of the finger. A sinus forceps is introduced along the knife, which is then withdrawn. The forceps is opened and withdrawn and a rubber tube is introduced into the abscess and sewn to the skin of the perineum. When the abscess is small the surgeon would be wise to proceed more warily by dissection. The following method, described by Dr. Lusk,[1] is a good one. He prefers to open the abscess through the fore part of the ischio-rectal fossa, behind the base of the triangular ligament, and between the anterior borders of the levatores ani. In this way the urethra is not opened, and the danger of cystitis and the troubles of a urinary fistula are avoided.

I think Dr. Lusk's way is the best for the cases indicated by him, and it is an easy and safe method. There is hardly any danger of injuring the rectum, which is separated from the wound by the levator ani and anal fascia. The structures in the perineal triangle and those between the triangular ligament are entirely avoided, while the pubic vessels and nerves are left ensheathed by the obturator fascia in the outer wall of the ischio-rectal fossa.

[1] *Ann. of Surg.*, January 1907, p. 103.

Dr. Alexander [1] opens all prostatic abscesses through the prostatic urethra into which he introduces a finger through an opening made into the membranous urethra upon a grooved staff. A finger of the other hand is introduced into the rectum as a guide, and the finger within the urethra tears through the mucous membrane and opens the abscess or dilates a pre-existing small opening. All trabeculæ are broken down, and a free opening is made. The bladder is then drained through a tube introduced into the perineal wound. A few strips of gauze are passed alongside the tube as far as the opening into the abscess cavity, which is not packed.

Dr. Alexander's method is a rapid and excellent one for late cases in which the abscess has opened into the urethra.

PROSTATIC CALCULI

These must be distinguished from calculi descending from the bladder into the prostatic urethra and not uncommonly lodged there for some time. True prostatic calculi commence in the ducts of the prostate, which are often somewhat dilated and sacculated. They are rare and are generally found in men over middle age who have some obstruction in the urethra, which has caused dilatation and inflammation of the prostatic ducts. The calculi are generally small, but may sometimes be of considerable size. There may be hundreds of minute calculi in the prostate, some of them being polygonal with sharp angles. They are generally brown and sometimes almost black in colour. They often give rise to considerable enlargement of the prostate with some obstruction to the flow of urine from the bladder. Occasionally a calculus lodges in the anterior urethra and causes retention of urine. Prostatic are apt to be mistaken for vesical calculi, and some of them may be pushed back into the bladder by the introduction of an instrument along the urethra. As a catheter, and especially a sound, is passed into the bladder, the calculi are felt before the instrument slips into the bladder. X-ray examinations are somewhat difficult, but they have sometimes demonstrated a multitude of small calculi in the prostate. Cystoscopic examination excludes a stone in the bladder, and may reveal enlargement of the prostate.

Operation. Prostatic calculi have been removed generally through a median perineal section (p. 664), finger and forceps being intoduced into the prostatic urethra for the removal of the stones ; but some of them may be left behind so that recurrence is not uncommon. In some cases the urethra has not been opened, but the stones have been removed through the posterior surface of the prostate. In some cases suprapubic prostatectomy is indicated, and it certainly has the great advantage of removing the manufactory and also the urethral obstruction and the associated cystitis as in the following interesting case.

Dr. M., aged 76, a fine looking man but rather stout. He has been remarkably healthy except that he had renal colic when quite a young man, and passed several stones. He also had a stone crushed by Sir Henry Thomson forty-three years ago. He has passed several small stones since then, and has had renal colic on both sides. He has very rarely been able to sleep all night, having to get up and pass water once or twice as a rule, but during the last two years he has been much worse in this respect. During the last year he has been getting up about six times every night, and has been having a good deal of pain and frequency of micturition during the daytime as well. During the last few months Dr. Mackern has been looking after him for cystitis, bleeding, occasional retention, pain in the glans and perineum,

and some distension of the abdomen. He has found it impossible to pass a catheter on him, but a week ago when urgent signs of retention came on, Dr. Mackern was able to pass a sound, and he then felt a stone which he must have dislodged from the urethra, for the patient was very much better after it and passed two stones, and it was thought that an operation, which had been contemplated the next day, would prove unnecessary. However, the symptoms returned during the week and the patient was a great deal worse and had very foul urine. No catheter could be passed. I saw him on March 1. 1913. at 10 P.M. His nurse had kept a record and it appeared that he had to pass water about every half an hour, so that he slept very little. The bowels were also opened at the same time. He was very miserable, having to use morphia suppositories to get any relief. I found the bladder distended, passed a catheter and withdrew 33 oz. of urine, leaving some in the bladder. This gave a good deal of pain when the bladder was getting empty. During the passage of the black Coudé catheter I felt it passing over several stones. I ordered him some

Acid. Sod. Phos.	.	.	.	.	.	.	.	gr. xv
Urotropine	.	.	.	.	.	.	.	gr. x
Tinc. Bellad.	.	.	.	.	.	.	.	gr. xx

He slept for several hours continuously during the night, and on the 2nd he was removed to a nursing home. He was not able to pass any urine until he arrived at the home, when he passed a little. At 6 P.M. on the 2nd I washed his bladder out with bicyanide of mercury $\frac{1}{1000}$, and left 6 oz. of water in afterwards. This relieved him a great deal, and he slept for four hours continuously and again for two hours continuously during the night, having taken 30 grains of aspirin only.

Operation on March 3, 1913, *at* 9 A.M. Dr. Shipway gave chloroform following morphia (gr. $\frac{1}{6}$) and atropine (gr. $\frac{1}{100}$). The bladder was washed out carefully, and some boracic lotion was left in. The bladder was opened through a vertical incision above the pubes, and was found to be very large and fasciculated, but it contained no stones. The prostate was enlarged, being about three times its natural size. It was very hard and full of stones. On passing the finger down into the prostatic urethra these could be felt. They were hard, angular and projected into the urethra. I scraped through the mucous membrane at the back of the urethra, thus enlarging the vesical orifice, and dislodged about half a dozen large stones into the bladder. There were a great many more to be felt in the prostatic tissue, which I therefore enucleated in the usual way with two left fingers in the bladder and two gloved right fingers in the rectum. With a great deal of difficulty I dislodged the prostatic stones into the bladder, removed the glove, and proceeded to remove the stones from the cavity of the bladder. This proved to be very difficult as there were so many little stones scattered about. I washed out the bladder and a good many of them came out into the wound. A gauze roll was then passed into the bladder and many other stones came out with the gauze. When the bladder was quite clean a large rubber tube was inserted. The contracted bladder gripped it firmly. The tube was fixed with salmon-gut, and three mass X salmon-gut sutures were inserted above the tube. The patient lost a fair but not a great amount of blood. It was thought wise, however, to infuse him into the armpits immediately after the operation, one pint of saline being passed into each axilla. Thirty grains of aspirin were also given by the rectum. The patient did well. The bladder was irrigated once a day with boracic solution. He passed some water in the natural way on the eighth day. The wound was very small and healed rapidly, the tube being removed on the fourth day. The patient made a rapid and complete recovery. Two years later he died of carcinoma of the rectum.

CHAPTER XXXIX

OPERATIONS ON THE URETHRA AND PENIS

RUPTURED URETHRA

In a few cases the surgeon may succeed in passing a catheter into the bladder, and he is most likely to do so by keeping the point along the roof of the urethra, for this is the part which most frequently escapes injury. When there is little or no bruising it is enough to secure a catheter in position to drain the bladder for about a week, but if any sign of urinary extravasation develop a free median incision must be made into the inflamed tissues without delay. If the instrument enter the bladder in a case where there has been much bruising [1] of the perineum and extravasation of blood, a median incision should still be made to allow of relief of tension and escape of breaking down clots, and so give good drainage. If this is not done, the probability is great that a little later, owing to damage of soft parts, tension of blood clot, and a little escape of urine by the side of the catheter, this step will be required at a time when, from the presence of septic fever, and the condition of the extravasated blood and urine, the occasion is less favourable.[2] Again, though a catheter can be passed at the time, it by no means follows that when, owing to it being plugged, or from some other reason, it requires removal in a few days, a fresh one can be inserted. An incision will then have to be made, and, as already stated, under conditions less favourable.[3]

When, as is usually the case, a catheter cannot be passed into the bladder, the patient is placed in the lithotomy position, and the parts having been shaved and cleansed, a No. 10 gum elastic catheter with stilette is passed as far as it will go, i.e. to the site of the rupture, and held by an assistant.

The surgeon, sitting facing the perineum, makes a median perineal incision, or if the rupture is far back a transverse or curved one for better exposure, the wound is gradually deepened.

With the finger clots are now turned out, and, retractors being inserted, the wound is sponged out thoroughly. A good deal of bleeding may take place from some wounded vessel, hitherto closed by extravasated blood, or from the crus penis, detached on one side by the violence which ruptured the urethra, especially if there be a fractured pelvis. This

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[1] Complete rupture of the urethra may co-exist with a mere contusion of the perineum, especially if much tenderness is present.

[2] Kaufmann (Von Bergmann's *System of Practical Surgery*), out of 44 cases, found that the catheter had to be removed in 22, for extravasation had occurred in 3. Perineal abscess had developed in 9, and extensive sloughing in 10 ; five of the patients died from these complications.

[3] Mr. Rutherford (*Glasgow Hospital Reports*) advises suprapubic puncture in addition to any other procedure, and describes three cases in which he adopted this plan with advantage.

hæmorrhage will yield to firm pressure or to forci-pressure. The anterior end of the urethra is next readily found by the end of the catheter, which projects through it. When only the floor of the urethra is divided the bruised edges are pared and brought together with catgut sutures. When the urethra is completely divided the finding of the deeper or vesical end, often difficult, will be facilitated by careful sponging, a mirror and reflected light, pressure above the pubes, and the use of fine probes or straight gum-elastic catheters. The end is often indicated by adherent clot or bleeding-point; at other times it resembles a partly twisted artery.[1]

If it be found, the catheter in the anterior urethra is passed on into the bladder, guided by a finger in the wound, a Brodie's probe, or a Teale's gorget (Fig. 292). If this be found impracticable, a catheter should be passed into the bladder from the wound. One of these methods should always be made use of, if possible, as it enables the patient to be kept dry by tubing attached to the catheter.

But if no catheter can be got into the bladder, either through the penis or from the wound, the surgeon need not worry himself as long as a free exit has been given for the urine and extravasated blood. In these cases it is not unusual for the bladder to become somewhat distended during the first two or three days, owing to the urine not escaping with sufficient freedom, or to the closure of the vesical end of the urethra from swelling after the injury and the manipulations to find it, or from the patient, if a child, shrinking from passing his water. This difficulty will usually be met by hot flannels frequently applied to the abdomen, and a few doses of laudanum, but if it be evident that the urine does not escape with sufficient freedom, the surgeon must again examine the wound with the aid of an anæsthetic, clean out any fresh clots, and again try to find the vesical end of the urethra, aided now, perhaps, by a better light.

If this fail, suprapubic tapping or aspiration, or if the patient's condition be good, making a small suprapubic opening into the bladder and thence passing a short curved staff into the perineum, and so finding the vesical end of the urethra must be resorted to.

Suture of the Urethra. It is always advisable, if possible, to draw the ends of the urethra together on the catheter with a fine curved needle on a holder, and catgut sutures. But this is often difficult, and sometimes impossible. Interrupted catgut sutures are used first on the roof of the urethra as the latter is drawn aside on the catheter. Then the sides and floor are sewn. A soft rubber catheter is used and this should not stretch the urethra where it is sewn. When suture is effected, it does not abolish the need of subsequent regular use of catheters, and the perineal wound must be drained for a few days in any case, however well the surgeon may have been able to sew the urethra. Accurate suture diminishes the risk of stricture, but in any case the risk of this must be remembered and a bougie passed regularly as long as there is indication of narrowing of the urethra.

OPERATIONS FOR STRICTURE

The majority of strictures of the urethra are best treated by gradual dilatation with catheters of increasing size tied in, but in some cases either internal or external urethrotomy has to be adopted.

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[1] The farther back the tear, the greater, of course, the difficulty in finding the urethra.

EXTERNAL URETHROTOMY

This operation includes the different forms of perineal section with or without a guide, viz. Syme's, Wheelhouse's, and Cock's operations.

By some, **external urethrotomy** is reserved for those cases, such as Syme's, in which a staff can be passed through the stricture, and " **perineal section** " for those in which no such help is available, *e.g.* Mr. Cock's operation. As, however, these terms are readily confused by students, and as in Wheelhouse's operation a staff is used, though it cannot be passed through the stricture, I think it preferable to employ the term external urethrotomy, specifying which operation is meant by using the author's name, viz. Syme's external urethrotomy, &c.

Indications for External Urethrotomy. This operation is recommended when dilatation and internal urethrotomy are inapplicable or ineffective.

(1) Impermeable stricture.

(2) Strictures which do not yield to dilatation, or rather continue to present symptoms after being dilated or divided—in other words, contractile, multiple, tubular, irritable, and resilient strictures, in which dilatation is accompanied with much pain, or which rapidly recur. These are usually cases of false passages at the side of the real stricture, the instrument having been forced through the urethral wall just in front of the constriction and then back again into the dilated urethra behind.

(3) Traumatic constrictions are sometimes very intractable and are often best treated by external urethrotomy.

(4) Cases in which rigors and constitutional disturbances follow any attempt at dilatation.

(5) When fistulæ, abscesses, extravasation, cystitis, or stone in the urethra complicate the stricture, it is best to use this operation.

Wheelhouse's operation is far more often employed than that of Syme, for the former is more generally applicable to all kinds of strictures, whereas Syme's operation needs a permeable stricture for its performance. Cock's operation is the most suitable for bad cases with acute retention, extravasation, or multiple fistulæ and diseased kidneys.

Syme's External Urethrotomy. Here the stricture is divided on a fine staff (*vide infra*) passed through it.

Operation. The patient, having been prepared by mild aperients and bland liquid diet for the operation, is brought under an anæsthetic, and the surgeon introduces a Syme's staff. This has a narrow terminal portion which passes through the stricture, a shoulder which rests upon the face of the stricture, and a wider, stouter part above the shoulder to make the instrument easier to find in the perineum. The patient being placed, in a good light, in lithotomy position, and the parts cleansed and shaved, the surgeon makes an incision exactly in the median line down upon the staff, exposing the wider portion above the shoulder. When the surgeon is certain that this is laid bare, he runs the knife forwards along the groove, so as to divide the stricture completely. The staff is now withdrawn, and the rest of the treatment must vary somewhat. If the condition of the patient admits of it, a No. 10 gum-elastic catheter should be passed from the meatus into the bladder, guided by a finger in the wound or in the rectum, or by a grooved director passed from the perineum. If the irritability of the parts does not admit of this, a gum-elastic catheter must be inserted from the perineum, cut short, and kept *in situ* with tapes,

the urine running off, by tubing attached, into a basin containing carbolic acid lotion ; or Prof. Syme's curved perineal catheter may be employed.

As soon as a catheter can be passed from the meatus, it should be kept in for a week or ten days if possible and only changed if it gets blocked. An attempt to flush the catheter with boracic lotion is often successful. Acid sodium phosphate and urotropine are administered to keep the urine sweet and acid, and if necessary the bladder is washed out daily with boracic lotion. When the perineal fistula closes the catheter is passed at first every day and left in for half an hour and later at increasing intervals. The patient should be clearly told of the absolute necessity which exists of keeping up the good effects of the operation by the passage of an instrument at regular intervals, and of keeping under observation for at least six months.

Wheelhouse's External Urethrotomy. Here the stricture is first found by a staff passed down to it, and then divided on a fine probe-pointed director passed through it.

Mr. Wheelhouse [1] recommends his method as having " the advantage of greatly increased precision. It renders an operation, confessedly hitherto one of the most difficult in surgery, a comparatively easy one, and one which, in my hands and in those of my colleagues, has given results infinitely more favourable, with an immediate and ultimate effect upon our cases, than we had ever seen before its introduction."

FIG. 290. Wheelhouse's staff.

Operation. " The patient is placed in lithotomy position, with the pelvis a little elevated, so as to permit the light to fall well upon it, and into the ground to be made. The staff [2] (Fig. 290) is to be introduced with the groove looking toward the surface and brought gently into contact with the stricture. It should not be pressed much against the stricture, for fear of tearing the tissues of the urethra and causing it to leave the canal, which would mar the whole after-proceedings, which depend upon the urethra being opened *a quarter of an inch in front of the stricture.* Whilst an assistant holds the staff in this position, an incision is made into the perineum, extending from opposite the point of reflection of the superficial fascia to the outer edge of the sphincter ani. The tissues of the perineum are to be steadily divided until the urethra is reached. This is now to be opened, *in the groove* of the staff, *not upon its point,* so as certainly to secure a quarter of an inch of healthy tube immediately in front of the stricture. As soon as the urethra is opened, and the groove in the staff fully exposed, the edges of the healthy urethra are to be seized on each side with straight-bladed nibbed forceps and held apart. The staff is then to be gently withdrawn until the button-point appears in the wound. It is then to be turned round, so that the groove may look to the pubes, and the button may be hooked on to the upper angle of the opened urethra, which is then

[1] *Brit. Med. Journ.*, June 24, 1876.
[2] This is fully grooved through the greater part, but not through the whole of its extent, the last half-inch of the groove being " stopped " and terminating in a round button-like end.

held stretched open at three points thus (Fig. 291), and the operator looks into it immediately in front of the stricture. While thus held open, a probe-pointed director [1] is inserted into the urethra, and the operator, if he cannot see the opening of the stricture, which is often possible, generally succeeds in very quickly finding it, and passes the point onwards *through* the stricture towards the bladder. The stricture is sometimes hidden amongst a crop of granulations or warty growths, in the midst of which

End of
Wheelhouse staff

Retractor holding
urethra open
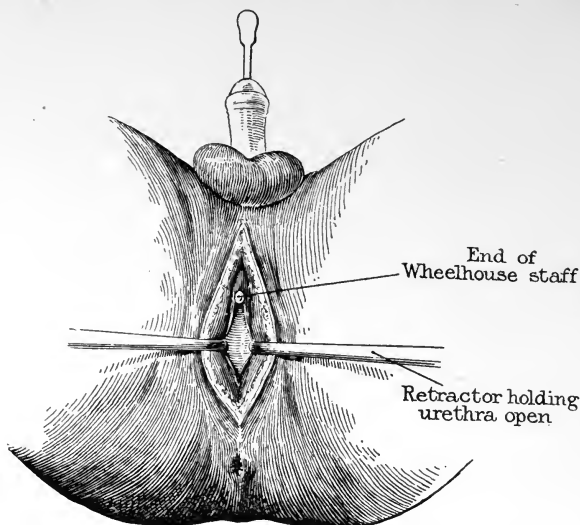
FIG. 291. Wheelhouse's operation. The urethra has been opened in front
of the stricture.

the probe-point easily finds the true passage. The director having been passed into the bladder (its entrance into which is clearly demonstrated by the freedom of its movements), its groove is turned downwards, the whole length of the stricture is carefully and deliber-
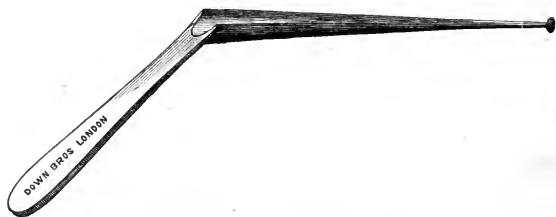
FIG. 292. Teale's probe-gorget.

ately divided on its under-surface, and the passage is thus cleared. The director is still held in the same position, and a straight probe-pointed bistoury is run along the groove to ensure complete division of all bands or other obstructions. These having been thoroughly cleared, the old difficulty of directing the point of a catheter through the divided stricture and onwards into the bladder is to be overcome. To effect this, the point of a probe-gorget (Fig. 292) is introduced into the groove

[1] Or a common blunt-pointed probe may be used. Occasionally a bougie (No. 2 or 3) is useful.

in the director, and, guided by it, is passed onwards into the bladder dilating the divided stricture, and forming a metallic floor, along which the point of the catheter cannot fail to pass securely into the bladder. The entry of the gorget into the latter viscus is signalised by an immediate gush of urine along it. A silver catheter [1] (No. 10 or 11) is now passed from the meatus down into the wound, is made to pass once or twice through the divided urethra, where it can be seen in the wound, to render certain the fact that no obstructing bands have been left undivided, and is then, guided by the probe-gorget, passed easily and certainly along the posterior part of the urethra into the bladder (Fig. 293). The gorget is now withdrawn, the catheter fastened in the urethra and allowed to remain for three or four days, an elastic tube conveying the urine away. After three or four days the catheter is removed, and is then passed daily, or every second or third day, according to circumstances, until the wound in the perineum is healed ; and after the parts have become consolidated it requires, of course, to be passed still from time to time, to prevent recontraction."

This will be found a most effectual operation, but in many cases the hitting off of the mouth of the stricture is a less simple matter than would be gathered from Mr. Wheelhouse's account. This is especially the case when the parts are engorged and

Wheelhouse guide

FIG. 293. Wheelhouse's operation. The probe-gorget is used to guide the catheter into the bladder.

softened, as the free oozing which is met with under these conditions may be most difficult to arrest even with firmly applied sponges on holders, the slightest trickling of blood being sufficient to obscure the orifice of the stricture. A false passage at the site of the stricture may complicate matters very much, and a stricture in the penile portion of the urethra may prevent the passage of the staff altogether. A good light, gentleness, and patience are at all times requisite.

Excision of Stricture. Occasionally a firm, annular, nodular or traumatic stricture may be excised after König's method, the urethral ends being sutured as for ruptured urethra. In other cases a good deal of periurethral scar tissue may be dissected away with the object of lessening the chance of recurrence of the stricture. Grafting operations for the reconstruction of the urethra after more extensive resections or traumatic destruction have not been attended with encouraging success.

[1] A soft catheter is better and safer to tie in.

Cock's Operation. An external urethrotomy, which opens the urethra behind the stricture, and without a guide (Fig. 294). The following, in the words of its deviser, are the *advantages* of this operation, so well known to Guy's men: [1] " The bladder is reached without any unnecessary mutilation of the perineum. The communication is effected in nearly a straight line from the exterior to the cavity of the viscus, so that the cannula, which is inserted and retained, can be removed whenever necessary, and can be easily replaced. The functions of the entire urethra are suspended, and may be kept in abeyance for an unlimited period. The urine no longer finds its way abnormally through the stricture and sinuses of the perineum. The tissues are no longer subjected to constant irritation from infiltration. The constitutional symptoms are relieved, and time and opportunity are given for the

Prostate.

Stricture.

Cock's knife entering dilated urethra.

Left index finger on the rectum.
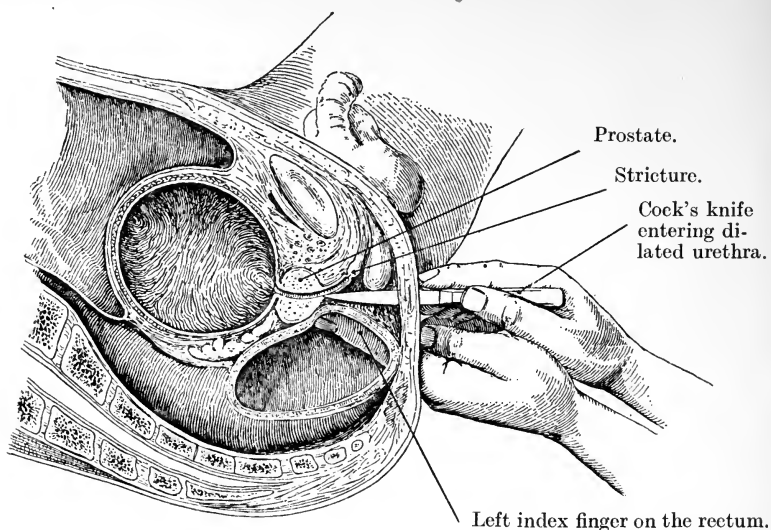
FIG. 294.   Cock's operation.

removal by absorption of those adventitious products which obstructed the urethra, indurated the perineum, and rendered the introduction of an instrument impossible. The pressure on the kidneys is removed, and, if expedient, the bladder may be readily washed out, until its lining membrane assumes a healthy character. The strictured and damaged portion of the urethra being no longer subjected to the constant pressure of urine from behind, may probably so far recover itself as to allow of restoration by the ordinary means of dilatation ; or, should the canal have become permanently obliterated, the patient still retains the means of emptying his bladder through the artificial opening without difficulty or distress, and at very moderate inconvenience to himself."

The following are *the cases to which the operation is well suited :* where the stricture has existed for a number of years ; where the urethra has become permanently obstructed or destroyed by the constant pressure of urine from behind, and by reiterated attempts, generally fruitless, to introduce an instrument ; where extravasation into the perineum has again and again taken place, causing repeated

[1] *Guy's Hospital Reports,* 1866, vol. xii, p. 267.

abscesses and their consequences, the formation of urinary sinuses and fistulæ, until the normal textures of the perineum become obliterated, and are replaced by an indurated, gristly structure; where the bladder has become thickened and contracted by the constant action of its muscular coat until little or no cavity is left; and where the urine is constantly distilling by drops either through the urethra or through one or several fistulous openings, which dot the surface of the perineum, penetrate through the indurated scrotum, and even find their way to the nates below, and the region of the pubes above. If unrelieved, these cases invariably terminate fatally. Fortunately they are uncommon at the present day. *Cases of stricture with acute retention and extravasation of urine are very quickly and easily relieved by the operation, for the urethra is distended behind the stricture.*

The keystone of the whole proceeding is the fact that, "however complicated may be the derangement of the perineum, and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy, often dilated, and accessible to the knife of the surgeon. I mean that portion of the urethra which emerges from the apex of the prostate—a part which is never the subject of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator."

Operation. The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum, the bearings of the prostate are next examined and ascertained, and the tip of the finger is lodged at the apex of the gland. The knife [1] is then plunged steadily, but boldly, into the median line of the perineum, and carried on in a direction towards the tip of the left forefinger, which lies in the rectum. At the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus.

"The knife should never be withdrawn in its progress towards the apex of the prostate, but its onward course must be steadily maintained, until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative position of his finger, the apex of the prostate, and the point of his knife, the latter is to be advanced with a section somewhat obliquely either to the right or the left, and it can hardly fail to pierce the urethra where the later is distended and enlarged between the prostate and the stricture. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

"In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when reinserted, make a fresh incision and complicate the desired result. It will be seen that the wound, when completed, represents a triangle, the base being the external vertical incision through the perineum, while the apex, and consequently the point of the knife, impinges on the prostate. This shape of the wound facilitates the next step of the operation.

[1] Cock's knife is double-edged.

"The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and, guided by the left forefinger, enters the urethra, and is passed into the bladder. A No. 12 gum-elastic catheter, straightened on its stylet, is slid along the director, the stylet then removed, the catheter cut short, and secured in position with tapes."

About ten days later catheters of increasing sizes are passed through the stricture into the bladder and tied in until the passage is well dilated.

After-treatment. After external urethrotomy there is a tendency for the stricture to return, therefore it is imperative to pass a bougie or conical sound of suitable size at regular intervals for at least a year.

Complications and Causes of Failure after External Urethrotomy. (1) Hæmorrhage. (2) Rigors. These should be met by warmth; leaving out the catheter or substituting a softer one; plenty of diluent drinks; washing out the bladder with diluted Thompson's fluid, Dover's powders, or small injections of morphia, if the condition of the kidney admits of these. Five or ten grains of quinine may be given in milk every two or three hours, if it does not excite vomiting. (3) Septic trouble, *e.g.* septic phlebitis. (4) Pelvic cellulitis. (5) Persistence of a fistulous opening in the perineum. (6) Recurrence of the contraction.

THE TREATMENT OF STRICTURE-RETENTION

When the obstruction is not quite complete, or the need for relief very urgent, a few hours' rest in bed, opium, warm hip baths, or fomentations often allay spasm and succeed in enabling the patient to pass water and empty the bladder either partially or completely. Then, if not before, a small soft catheter (size $\frac{1}{2}$ to 3 silk web, or soft black) can generally be passed and tied in. The stricture soon dilates sufficiently to allow the urine to pass by the side of the catheter, if the latter fails to drain. Once he has succeeded in passing even the smallest catheter or bougie the surgeon must not remove it in the hope of being able to introduce a larger one, for he may then find that he cannot even reinsert the original one. After one or two days a larger instrument can be passed if used immediately after the withdrawal of the first one. Larger instruments can be tied in daily until the dilatation is completed.

The introduction of the catheter may be greatly aided by injecting a solution of adrenalin chloride ($\frac{1}{1000}$) with cocaine 2 per cent. into the urethra to diminish the congestion of the mucous membrane at the stricture, and to abolish tenderness of the urethra and the resulting muscular spasm. Distension of the urethra with warm sterile olive oil is also useful. The oil is kept in during the passing of the catheter by holding the meatus firmly around the instrument. The distension serves to remove folds of mucous membrane, to dilate the stricture slightly, and especially to displace the orifice backwards, so that it lies at the apex of the funnel formed by the urethra in front of it. Without distension of the anterior urethra the stricture often projects forwards perhaps eccentrically into the lumen like an intussusception. So that a catheter fails to enter an opening which is quite large enough when its position is corrected.

Failing the introduction of a fine catheter, filiform bougies may be tried, and with perseverance one of these can be passed in most cases, with the aids mentioned above. The urethroscope may be useful in localising the orifice and also in conducting and introducing the bougie

with the aid of sight. Sometimes a catheter can be passed upstream as the patient succeeds in voiding a little urine. Once a bougie has been got through the stricture, it may either be tied in or used as a guide for a " tunnel " or " railway " catheter to run along.

A conical silver catheter can be screwed on to a suitable bougie and slowly made to follow the latter into the bladder without any risk of making a false passage. The bougie coils safely within the bladder. This plan is far better than to attempt forcibly to dilate a stricture with a metal catheter without any guide. In most cases such attempts either fail altogether or succeed only by making a false passage by the side of the real canal of the stricture. By keeping the point in the middle line a skilful surgeon may direct his instrument back again into the urethra where the latter is fortunately dilated behind the stricture, but although a good anatomist may succeed in entering the bladder and in affording immediate relief in this way, the method is too dangerous to be recommended for general use, and, moreover, the ultimate results are often poor, for the false passage usually recontracts, and obstruction returns sooner or later. Such false passages are sometimes misnamed resilient strictures.

In most cases where the patient is still comparatively young, where the stricture is not of long duration, where there are no urinary fistulæ or a damaged perineum, the retention can be relieved and the cure of the stricture started in one of the ways mentioned above, but in others all such attempts may fail, especially owing to the existence of recently made false passages and hæmorrhage from injudicious instrumentation.

It will have been gathered from the remarks at p. 660 that **supra-pubic aspiration** may be used in very urgent cases, and may be repeated safely once if necessary. For the large majority of cases of acute and complete retention due to impermeable stricture, especially when the patient is under 45, and a few days' rest will ensure the passage of a catheter, I believe that suprapubic tapping of the bladder will be the safest and simplest operation (p. 661). This will be followed in four or five days by the passage of a catheter, aided by an anæsthetic perhaps. Wheelhouse's operation is very highly spoken of by the Leeds surgeons. A good light and especial instruments are essential. The cases to which Mr. Cock's excellent operation should be limited have been already pointed out (p. 722).

INTERNAL URETHROTOMY

Indications. Before specifying these, I would say that with regard to the question between external and internal urethrotomy, or the need of either, it is chiefly a matter of personal experience. In other words, surgeons who practise usually some such operation as that of Prof. Syme—or use Mr. Wheelhouse's method—when careful dilatation, aided by an anæsthetic, fails, will probably have as good results as those who resort to internal urethrotomy. As it is a clean division of the entire stricture which is required, this can be effected most readily, and with less practice, and with simpler instruments, by external urethrotomy ; but internal urethrotomy has the great advantages of avoiding a urinary fistula except as a very rare complication and of saving much time. But it must be remembered that, after all, it is not so much the division of the stricture, whether from without or within, which will be curative, as the

amount of perseverance which the patient shows afterwards. Again, at the commencement of internal urethrotomy each stricture must be dilated sufficiently to admit, in the case of an instrument cutting from before backwards, a split sound equivalent to No. 2 English, while in instruments cutting in the opposite direction the bulb is as large as No. 4 or 5. This being so, the cases must be few in which the surgeon does not find it possible, and in which the patient does not prefer to complete the case by gradual dilatation.

Amongst these few cases are—(1) Strictures localised and annular, which (α) contract rapidly after dilatation, or (β) in which rigors persistently follow attempts at dilatation. (2) Non-dilatable strictures, *e.g.* some traumatic ones. (3) Penile strictures. These are very elastic, and shrink quickly after dilatation, and incision of these strictures seldom causes serious constitutional disturbance. (4) In some cases where time is an object. Thus, in young subjects whose disease has not existed long enough to alter the condition of the kidneys, cutting may be admissible for a stricture that should be simply dilated in an older
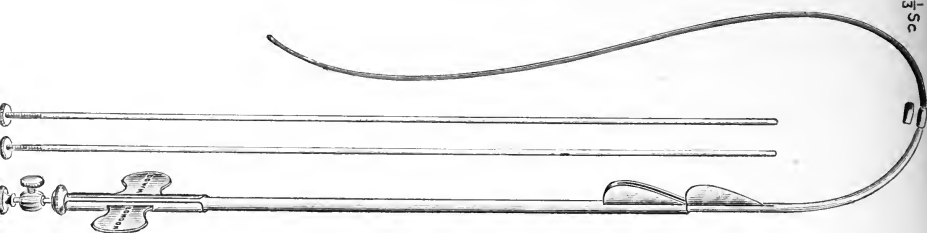
Fig. 295.   Teevan's urethrotome.   This divides the stricture from before backwards.

patient whose kidneys have undergone degeneration.[1] (5) According to some,[2] urethrotomy affords a longer interval of freedom from contraction than does any other plan of widening a stricture. The urethroscope may occasionally afford useful information which may not only enable the surgeon to decide upon internal urethrotomy, but also indicates the exact direction and degree of the interference that is necessary. The operation can be carried out through the urethroscopic tube, with the aid of direct vision in some cases.

Contra-indications.   (1) Strictures not localised and ring-like, but extending over a considerable surface. (2) A " stricture " in which the difficulty is mainly due to congestion,[3] though this is scarcely a stricture at all. (3) A stricture accompanied by urethritis, or induration of the perineum with perineal fistulæ.

I have endeavoured to point out fairly the indication for internal urethrotomy. I suspect that this is one of those operations of which an increasingly frequent use is liable to lead to something very like abuse. But, however this may be, I should like to point out first a fallacy, as it seems to me. Thus, Sir H. Thompson[4] speaks of a urethrotome as

[1] Berkeley Hill, *Dict. of Surg.*, vol. ii, p. 727.
[2] Berkeley Hill, *loc. supra cit.*
[3] As bearing upon the allied condition of " spasm," the late Mr. B. Hill (*Brit. Med. Journ.*, 1879, vol. ii, p. 856) stated that if an apparently narrow bulbo-membranous and a penile stricture co-exist, on the latter being properly divided, the former will disappear, having been due to reflex muscular contraction.
[4] *Dis. of Urin. Organs*, p. 40.

" nothing more than a little knife with a long blade . . . used precisely as we use a scalpel anywhere else. Just as we should use a small knife in tenotomy without the sense of vision where it is not necessary, but guided by the sense of touch, so do I advise you to act in urethrotomy." No doubt this comparison is correct as far as it goes, but its very simplicity is misleading. There can be no real comparison, I maintain, between division of a tendon, which can always be practically made subcutaneous, and that of a stricture, perhaps four inches from the surface, surrounded by vascular tissue, incision of which may easily lead to hæmorrhage or septic trouble, an incision which cannot from the subsequent flow of urine be completed aseptically, and which implicates other parts in such intimate sympathy with that operated on, *e.g.* the kidneys.

Again, I would point out that internal urethrotomy is not the simple affair that it is sometimes represented to be. I would refer my readers to the experience of one whose name is associated with this operation. Mr. Berkeley Hill[1] speaks thus of a trial which he gave to the method of treating early stricture by Otis's operation of internal urethrotomy :

" All the cases operated on were those of long-standing gleets, with contraction in one or more parts of the spongy urethra, and had under-

FIG. 296. Otis's urethrotome. This divides the stricture from behind forwards.

gone multifarious treatment. The number of patients is sixteen, fifteen of my own and one of Dr. Otis's. In five cases the gleet stopped after the operation, and the patient was at the last report—taken in none less than three weeks, in most some months, after the operation— able to pass a bougie of the estimated size of the urethra. In short, they may be claimed as cures. But of these five the operation was serious to two : one had free bleeding for three days, the other three attacks of rigors. Of the remaining eleven, among whom Dr. Otis's own operation must be included, the gleet persisted in all ; in several the urethra shrank again to its size before the operation, and in some very serious complications ensued. In four bleeding lasted several days, and in one was alarming. Three patients had rigors. In two the shivering was unimportant, being that which follows the first transit of urine along the incised urethra in certain individuals, but is not repeated or attended by further consequences ; in the third patient the rigors preceded abscess in the buttock. One patient had orchitis. Thus in seven the operation might fairly be termed a trifle, causing no pain nor any after-fever, but in five only was the operation successful."

In skilful hands at the present day the dangers of the operation are very small when aseptic precautions are carefully observed. Consequently it has become more popular of late, and it gives good results when the after-treatment is properly carried out.

Lancet, April 8, 1876, p. 524.

Complications. (1) Hæmorrhage. If severe this may be met by pressure on the perineum. (2) Perineal abscess. (3) Sloughing and perineal fistula. These are very rare. (4) Extravasation. (5) Septicæmia. (6) Epididymitis. The first five of these are usually due to cutting too deeply, or to the patient not being sufficiently prepared or unfit for the operation. The last is usually brought about by injudicious haste in the use of bougies.

The essentials of a good urethrotome are : (1) a guide through the stricture into the bladder, usually in the form of a filiform guide-bougie, or of a curved terminal portion of the urethrotome, sufficiently fine to pass through the narrowest stricture ; (2) a cutting edge which, at first shielded, can be protruded by the surgeon as exactly as he desires ; (3) some means of steadying the mobile stricture fibres as they are divided.

Two Chief Modes of Internal Urethrotomy. The stricture may be divided : (*a*) **from without inwards,** *i.e.* **towards the bladder ;** (*b*) **from within outwards, away from the bladder.** A short account of the chief instruments will be given, and the two methods briefly contrasted.

(*a*) **Those cutting from without inwards.** By this means narrower strictures can be divided than in the other method, in which the instruments used are generally based on Civiale's pattern, in which the bulbous end carries the knife.

Most of the urethrotomes which cut from without inwards are modifications of Maisonneuve's pattern. A fine hollow staff being guided through the stricture by a filiform bougie, along the hollow staff a stylet carrying a triangular shield or wedge is run ; this, pushed against the stricture, serves to steady it, while it is divided by a knife concealed in the wedge or shield. Some of the simplest and best of these modifications are those of Teevan and Thomson Walker.

(*b*) **Those cutting from within outwards.** A good representative of these instruments is Sir H. Thompson's modification of Civiale's urethrotome. This has a bulbous extremity, from which the blade is protruded. The stricture being sufficiently dilated to admit a No. 4 or 5 bougie, the bulb (which forms a useful sound) is carried about one-third of an inch beyond the stricture, the knife projected, and the incision made by drawing it slowly and firmly outwards—to the distance of half an inch to two inches—generally along the floor of the urethra, so as to incise the stricture freely. A large conical steel sound with bulbous end is then passed, and if at any point it is held closely, there is still almost certainly some spot which needs touching with the blade.

Comparison of the Two Methods of Internal Urethrotomy. With the instruments which cut from without inwards, guided by a filiform bougie, narrower strictures can be attacked than by the bulbous-ended urethrotome, cutting in the reverse direction. These latter have been recommended as having the advantage of steadying the fibres to be cut by their pulling forwards the parts which attach the urethra to the pelvis as the bulbous end of the instrument is drawn out. The stricture is thus pulled on by the instrument until the divided stricture gives free passage to the bulbous shield and the knife protrudes from it. Mr. B. Hill, however, considered that " reliance cannot be placed on the simple straining of these attachments ensuring perfect division of the stricture tissue. A Civiale's or any other urethrotome which cuts from within outwards is very apt to wriggle its way through a stricture, only scoring

it, but not perfectly severing its fibres, and to meet this difficulty the knife is often carried more deeply than is necessary." Mr. Hill further believed that by cutting from without inwards there is less risk " of making an incision through a thin layer of fibrous tissue into erectile tissue, in the belief that a thick layer of fibrous tissue exists," and thus of causing free hæmorrhage.

After-treatment. A full-sized catheter is tied in for two days, otherwise there may be a good deal of pain and difficulty in urination. After this the patient passes his water without difficulty. He is kept in bed for a week and the urethra is irrigated daily if urethritis develops. On the tenth day a large-sized conical sound is passed, and the patient returns once a week to have the instrument passed. After six weeks he need come only once a fortnight, and another six weeks and then only once a month if no difficulty is encountered. If there is no contraction at the end of a year the patient may be regarded as cured.

Removal of Calculi from the Urethra. (1) A calculus obstructing the urethra may have descended from the bladder, and is often renal in origin. Impaction of a calculus from this source is not uncommon in infants or young children as well as in adults. As a rule they become arrested in the penile urethra often just behind the glans.

(2) In older patients calculi sometimes form behind a stricture generally in the posterior part of the urethra.

(3) Prostatic calculi also invade the urethra.

A calculus impacted in a normal urethra is generally found in the anterior urethra, and in many cases it can be removed with forceps after incising the meatus downwards. When the calculus is further back and cannot be dislodged with forceps a longitudinal incision should be made directly over it, and the urethra sewn up with interrupted catgut sutures, which do not pierce the mucous membrane. The skin is sewn with interrupted sutures, a temporary gauze drain being left between the sutures to guard against extravasation.

When a calculus is impacted behind a stricture, the latter must be treated at the same time. External urethrotomy is performed after Wheelhouse's method and the calculi behind the stricture are withdrawn with forceps. This may be very difficult in some cases. If there is much cystitis or induration with fistulæ or abscesses in the perineum, the bladder must be drained for a few days through the perineum, and when the wound is clean a catheter is passed through the penis into the bladder and tied in.

Calculi in the prostatic urethra are very common, and are best removed through a median perineal incision, the membranous urethra being opened on a sound and the stones removed with long forceps.

HYPOSPADIAS

Varieties. These are three, viz.: (1) Glandular. The opening is here merely farther back than usual; the frænum is absent, the glans broad, flattened, somewhat recurved, and the prepuce, often hood-like, always in a condition of partial paraphimosis. (2) Penile. Here the urethra is especially liable to open at one of the three following sites: (*a*) just behind the glans; (*b*) at the middle of the penis; (*c*) at the junction of the penis and scrotum. (3) Scrotal. Here the cleft on which the urethra opens may be either at the junction of the penis and

scrotum, or involve the scrotum and perineum, the former being called peno-scrotal and the latter perineo-scrotal.

When an operation is under consideration with a view of rendering micturition and coitus normal, the surgeon must take into due consideration: (α) the degree of the deformity ; (β) whether the penis is fairly developed ; (γ) whether it is much tied down ; (δ) whether the testicles are present and descended ; (ϵ) how far the patient's condition is made miserable by rawness and eczema due to impeded micturition, and by impeded coitus, and how far there are reasonable hopes of remedying these.

In many cases, when there is no recurvation and the urethra opens just behind the glans penis function is not compromised, and there is no need to do anything beyond removing the hooded prepuce.
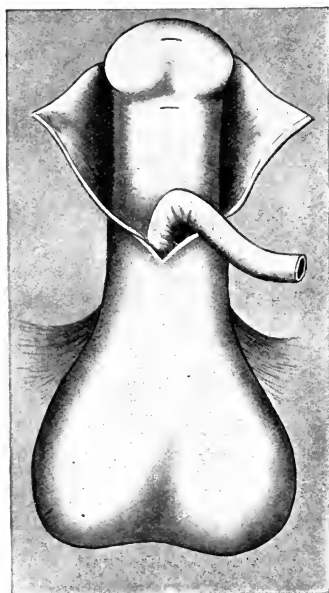
FIG. 297. Beck's operation. (Binnie.)   FIG. 298. Beck's operation. (Binnie.)
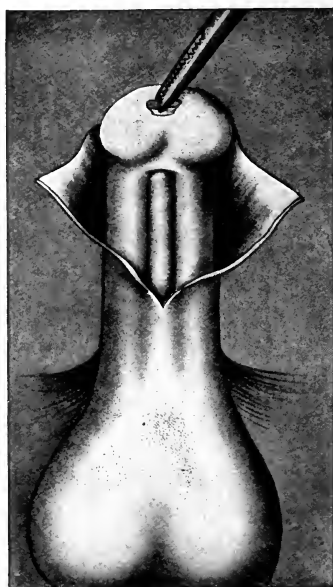
Time for Operation. The parts are so small and delicate that it is rarely wise to operate until the child is six years of age, and it is often wise to wait still longer, but not until after puberty, owing to troubles and difficulties arising from erection after the operation.

Operations for the slighter deformities will be considered first.

(1) **Beck's Operation.** This is suitable when the malplaced meatus is only a little way behind the glans. I have found it very successful in such cases.

The distal part of the urethra is isolated and mobilised as shown in Fig. 297, so that it can be brought forwards and sutured either to the urethral groove on the under-surface of the glans, or the anterior end of a perforation made in the latter (Oschner, *see* Fig.   ). The skin is then sutured over the urethra.

(2) **Van Hook and Mayo's Operation.** Dr. C. H. Mayo [1] pulls the prepuce well forward, and fashions from it and from the dorsum of the penis (if

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[1] *Journ. Amer. Med. Assoc.*, April 1901.

necessary) a flap about one inch wide and two and a half inches long.   The flap is left attached at its base near the corona of the glans, and its edges are sewn together, so that a tube lined with skin is formed (*see* Fig. 299).

A tunnel is then made with a narrow-bladed knife, which is passed through the glans, above the urethral groove, and out near the mal-placed urethral orifice near the root of the penis.   The new-formed
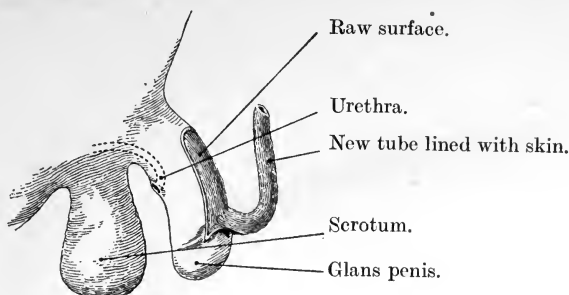
Fig. 299.   (After C. H. Mayo.)

tube is then drawn through the tunnel and fixed with sutures both at the glans and at its exit (*see* Fig. 300).

The gap upon the dorsum of the penis is closed.

About ten days later the base of the flap is severed just in front of the glans, and a new meatus is thus formed.
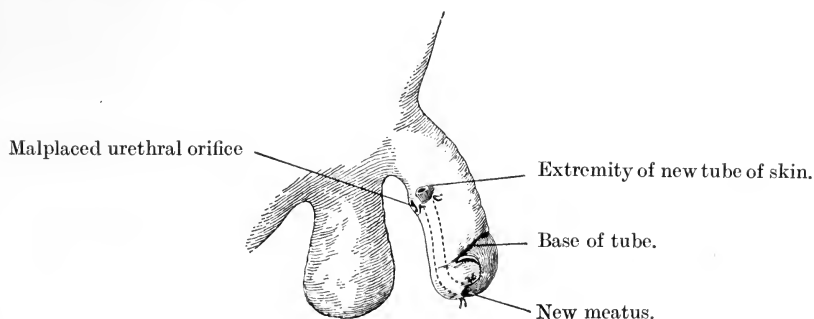
Fig. 300.   (After C. H. Mayo.)

At a second operation the urethra is opened in the perineum, and a self-retaining female catheter inserted (*see* Fig. 301) and left in for about a week.

The extremity of the old urethra is mobilised and implanted into the open end of the new part, and the skin wound closed.   As some urine often leaks into the urethra in front of the catheter, it is well to pass several strands of silkworm gut or horsehair through the urethra and out alongside the catheter in the perineal opening.

(3) **Mr. Bucknall's** [1] **Operation.**   I venture to quote Mr. Bucknall's own account of this operation.   "The penis is drawn up over the abdomen in the middle line and the scrotum is drawn down in the opposite direction between the thighs, so that the groove, usually present in

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[1] The *Lancet*, September 28, 1907, vol. ii, p. 887.

such cases, on the under-surface of the penis, the false meatus urinarius, and the scrotal raphé all occupy the median line (Fig. 302). Two similar incisions are now made on each side of the median line one-eighth of an inch from it and parallel to it. Each begins on the glans penis and is continued down the penis until opposite the misplaced urethra at its root. Each incision is now prolonged on to the front of the scrotum on each side of the scrotal raphé and parallel to it until the incisions on the scrotum measured from the level of the misplaced meatus are equal in length to those on the penis measured from the same point to the point of their commencement on the glans penis. When these incisions are completed a median strip of skin a quarter of an inch in width is mapped out, reaching along the upturned ventral surface of the penis and the front of the scrotum with the misplaced meatus at its centre. From the extremities of the

End-in-end anastomosis of the urethra.

Self-retaining catheter.
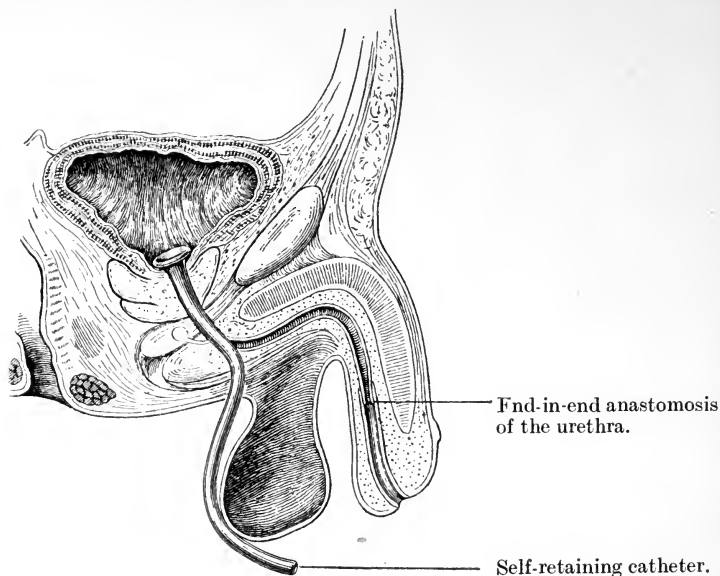
FIG. 301.   (After C. H. Mayo.)

two incisions bounding this strip of skin others are now made outwards at right angles, each a quarter of an inch in length (Fig. 302). In this way two longitudinal flaps are marked out on either side of the median strip of skin throughout its whole length. These flaps are dissected up off the sides of the penis and front of the scrotum respectively, and rolled outwards away from the middle line throughout their whole length (Fig. 303). Two long strips, each presenting a raw surface half an inch wide, are thus produced on either side of the median strip of skin previously referred to, which is left undisturbed. The flaps are held in the everted position with forceps throughout their whole length, and while in this position the penis is flexed down on to the scrotum in the middle line about a transverse axis passing through the misplaced urinary meatus (Fig. 303). The median strip of skin on the ventral aspect of the penis and the raw areas flanking it thus come to lie on the corresponding median strip and raw surfaces on the front of the scrotum. The penile strip of skin will form a roof for the new urethra and the scrotal strip will form its floor. The raw surfaces on each side, when properly sutured,

will cohere and grow together, fixing the penis to the scrotum and closing in the lateral aspects of the new urethral tube so as to render it water-tight. The parts now present the following appearance. The penis lies on the front of the scrotum in the middle line like a complete web penis, and on either side where they come together the opposed penile and
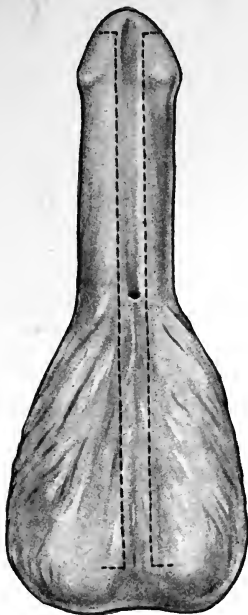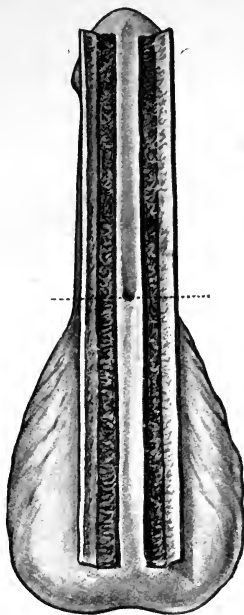
FIG. 302.　　　　　　　　FIG. 303.
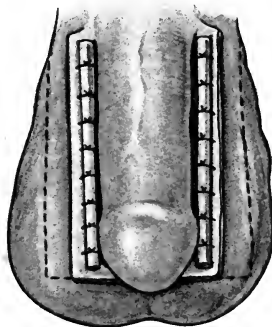
FIG. 304.　Bucknall's operation for hypospadias.

scrotal flaps project so as to form a flange about a quarter of an inch in width, which extends from the root to the tip of the penis. The penile and scrotal flaps forming each lateral flange are now sutured together in a special way. Each flange is transfixed by the needle, close to its free edge, and the needle is then reversed and passed through the flaps forming the flange in the opposite direction quite close to the attached borders of the flaps composing it. In this way a series of sutures are inserted at intervals of a quarter of an inch from the root of

the penis to its tip, each running transversely to the axis of the penis, across the skin surfaces of the penile and scrotal flaps (Figs. 304 and 305). In passing each suture through the attached base of the flap special care is taken that the needle almost, but not quite, takes up the edges of the strips of attached skin, which will form the roof and floor of the new urethra, for it is important to approximate the epithelial margins without the suture projecting into the new urethral lumen (Fig. 305). All the sutures are passed before any are tied, and before tying them two special manœuvres are carried out : (1) small rubber tubes are passed under the sutures on the front and back of each flange to avoid puckering of the skin and to keep up pressure over a broad area between the opposed raw surfaces of the flaps; and (2) a small rubber catheter, with the eye cut off, is passed along the track which will form the new urethra and pushed a short way down the previously formed urethra so as to drain off the urine without soiling the newly constructed portion A suture at the tip of the penis fixes the catheter in place. The parts are dressed with lead lotion every four hours. On the fourth day the piece of
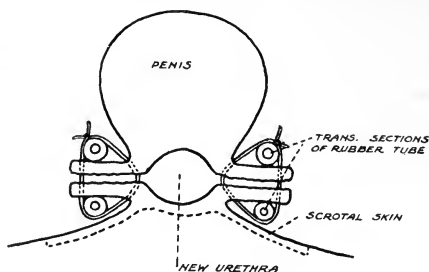
FIG. 305. Bucknall's operation for hypospadias. Transverse section of the penis and urethra.

catheter is removed and urine is allowed to pass down the new urethral tube. The sutures are all removed at the end of fourteen days and the parts are ready for the second operation in from three to four weeks if the patient's condition is still favourable. Otherwise the second operation can be postponed indefinitely."

" **Operation, Second Stage.** The penis and new urethra are dissected up from the scrotum, lateral flaps derived from the scrotum being left attached on either side of the penis to close in the raw surface beneath it (Fig. 304 dotted line, and Fig. 306). Other flaps are formed on the scrotum ; and by gliding them towards the middle line the raw surface on the front of the scrotum is easily closed (Figs. 306 and 307). If the lateral flanges used to unite the penis and scrotum in the first stage are seen to project too freely, they can be trimmed off either now or later to improve the cosmetic result."

Mr. Bucknall records three cases in detail. The first two cases had been watched five years and the third two years. The first two were followed for three years and remained as satisfactory in every way as could be desired. All the cases healed without delay and there was never any leakage or tendency to stricture.

" The advantages which may be claimed for this method of operating are as follows : (1) That it is performed in two stages, each of which can be rapidly accomplished. This lessens shock and enables the operation being done at an early age, the ultimate plastic result being all the better

in consequence. (2) That the skin utilised to form the roof and floor of the new urethra is not dissected up or even touched, consequently it retains its vitality and does not tend to slough as when flaps are used for this purpose. (3) That no sutures project into the lumen of the new urethra. (4) That the skin of the roof and floor of the new urethra is respectively in continuity with the roof and floor of the previously existing one. There is in consequence no tendency to the formation of a fistula or subsequent stricture at the site of the false meatus as so frequently happens when other methods are employed. (5) No buried sutures are necessary and the apposition of the broad raw surfaces afforded by the flaps on either side, supported by the rubber tubes, prevents any tendency to leakage.
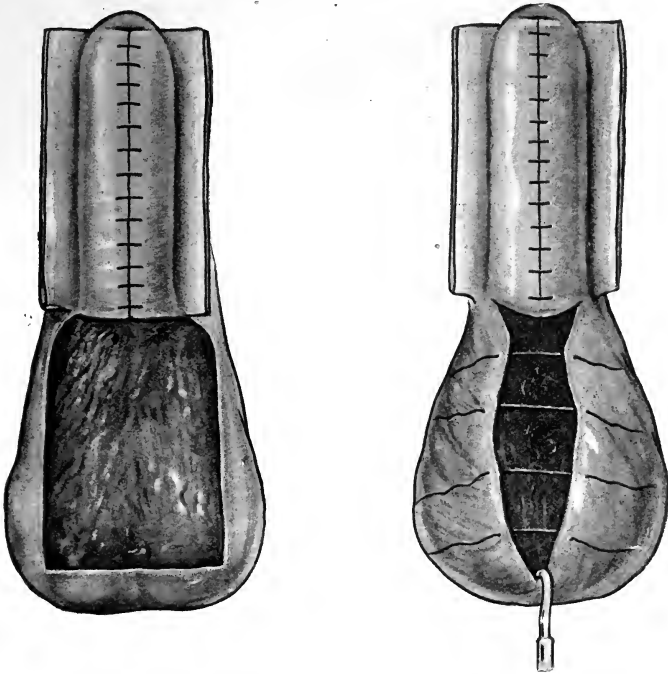
FIGS. 306 and 307. Bucknall's operation for hypospadias.

The disadvantages to be considered are two in number : (1) that the operation is only applicable if the scrotum is uncleft ; and (2) that hair may possibly grow later on in life from the skin of the scrotal raphé which is used to form the new urethral floor. The former disadvantage is minimised by the fact that by far the larger number of cases of hypospadias are of the penile variety, and that should the scrotum be cleft as well, the greatest trouble is not so much due to the deformity as to incontinence of urine, which is incurable."

EPISPADIAS

I shall not give any really full account of the different attempts to cure this rare condition. For some points of practical importance I would refer my readers to the remarks on hypospadias (p. 730).

Any attempt at curing epispadias should be divided into three stages, thus :

(i) *Straightening the Penis.* While the penis is short, recurved, so as to lie in contact with the abdominal wall, it is no use trying to complete the defective urethra. Attempts should be made to straighten the penis by dividing it subcutaneously close to the pubes, each corpus cavernosum being cut separately. In the only case in which I practised this, in a patient aged 17, the hæmorrhage was easily controlled by dry gauze and light pressure, but very sharp tenotomes must be employed, as the erectile tissue offers much less resistance than a tendon. Each corpus cavernosum should be divided completely, and as cleanly as possible. The penis must, for some time, be kept fastened down. Improvement in its position takes place gradually, together with increase in its length, this being eventually more marked the earlier the operation is performed.

(ii) *Making a Canal in the Glans Penis.* Two deep incisions are made parallel to the urethral groove ; a glass rod is then laid in this groove ; the lateral flaps are brought up and sutured over the rod (*see* Fig. 308).
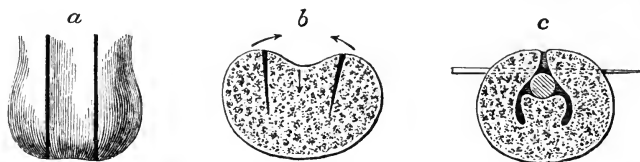
Fig. 308. Making a canal in the meatus. (After Esmarch and Kowalzig.)

(iii) *Completion of the Deficient Urethra from the Glans to the Epispadiac Opening.* The simplest way of effecting this is by the method of Thiersch and Duplay, much as in hypospadias, to the account of which I would refer my readers. Two narrow quadrilateral flaps, extending from the meatus to the epispadiac orifice, are marked out and dissected up from without inwards on either side of the open urethra, both being left attached in the middle line. These, turned with their mucocutaneous surface inwards over a small Jaques catheter, to form the new urethra, and their raw surfaces outwards, are united in the middle line with numerous points of sutures cut short and buried. Thin flaps dissected up from within outwards from off the dorsum and sides of the penis are then drawn inwards, raw surfaces being thus opposed to raw surfaces, and kept *in situ* by numerous points of suture. The continuity of the glandular and penile urethra is established at this operation.

(iv) *Junction of the Old and New Canal by Closure of the Epispadiac Opening.* This is effected by freely refreshing the surrounding parts and suturing them carefully, or a flap with its raw surface may be used (Cheyne). Before the union is complete several operations may be required both for this condition and hypospadias.

A modification of Bucknall's operation for hypospadias might also be used here, and the method of Van Hook and Mayo is also equally applicable.

In many cases epispadias and ectopia vesicæ co-exist ; there are all degrees of deficiency of the anterior wall of the bladder and urethra up

to complete ectopia vesicæ. In some cases the cleft extends from the meatus through the sphincter of the bladder. The following is a case of this kind.

Case of Incontinence of Urine Associated with Epispadias.[1] A boy, æt. 6, was sent to me early in June 1908 by Dr. B. A. Richmond, of Bermondsey, for incontinence of urine associated with epispadias. He was able to retain the urine fairly well while lying down at night, but directly he either stood or sat up it ran away. Throughout the day the water dripped into the clothes, keeping the trousers constantly wet and rotting them in a short time. Dr. Richmond wrote that " complaints were made at school that the boy was undesirable, because his clothes smelt so strongly. I hope that you will be able to recommend something to relieve a very distressing condition. The question is, can any plastic operation be done ? "

In other respects the boy was well developed, except that the right testicle was retained in the inguinal region, and that the symphysis pubis was depressed and thin. The penis was so extremely small, that only a little bud presented below the arched lower border of the pubic skin. The epispadias was nearly complete,
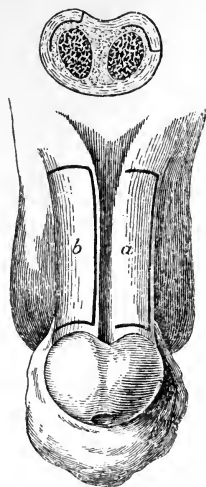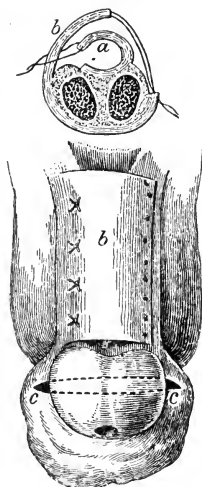
FIG. 309.   FIG. 310.

Thiersch's operation for epispadias. (After Esmarch and Kowalzig.)

but the cleft did not extend quite into the bladder, the posterior inch of the urethra being roofed over with mucous membrane only.

Diagnosis. It was obvious that the bladder was of fair size, because it was capable of holding all the urine secreted during the night, if the boy lay horizontal. The complete incontinence in the vertical position proved that there could be no sphincteric control. Gravity, atmospheric pressure and the apposition of the mucous walls of the urethra were usually sufficient to prevent leakage while the trunk remained flat and the muscles at rest. It was concluded, therefore, that although the cleft did not extend into the bladder, the sphincter had failed to meet in front of the urethra, and the neck of the bladder. It was hoped that some of the muscle fibres existed, but that they were powerless, because they had not been able to complete the circle that is necessary for control.

Treatment. In considering the treatment of this boy it was clear that it would be almost impossible to fit him with a urinal that would both keep him dry and make him " desirable " at school. It seemed to me that it was worth while for this boy to run a considerable risk in order to be rid of his incontinence, and to be saved from a pestilent urinal as a permanent necessity. I therefore recommended an operation, although the chances of complete success did not seem to be good. If the operation should fail a urinal could be used, or the urine could be diverted into the rectum in one way or another. In a few cases of epispadias with extension of

[1] Rowlands, *Medical Press and Circular*, January 27, 1909.

the cleft through the neck of the bladder, Trendelenberg had been able to construct a moderate sphincter by carefully suturing the freshened and liberated edges of the cleft. This has only been possible after mobilising the sacro-iliac synchondrosis so that the pubic bones could be brought together and wired.

Operation. At the end of July 1908 a lateral flap with its convexity to the right was raised from the thin cartilaginous symphysis, which was then divided vertically. The neck of the bladder and the short urethra were carefully separated from the pubic bones, which were retracted, leaving a gap of nearly an inch and a half between them. The subperitoneal fat was drawn up and the lower part of the bladder and the urethra were freely and carefully separated from their lateral attachments by blunt dissection. When the bleeding had been checked, no muscular or prostatic tissue could be seen in front of the neck of the bladder or urethra, whose anterior wall consisted of mucous membrane only. This was carefully saved. The lowest part of the anterior wall of the bladder was also very thin and almost devoid of muscular fibres.

By means of Lembert sutures of fine catgut the muscular fibrous tissues upon the sides of the urethra and the lower part of the bladder were brought together in front of the carefully preserved mucous membrane, which was thus invaginated. In this manner the passage was so narrowed that it firmly gripped a No. 4 self-retaining rubber catheter, which had been inserted. The lateral separation had been free enough to prevent undue tension upon the sutures. The edges of the pubic bodies were freshened and fixed in apposition by means of wire. The wound was accurately closed. At first all the urine drained away through the catheter, but this became blocked and had to be changed after the fourth day. When the instrument was finally removed there was incomplete control of the urine, both day and night, but gradually the incontinence diminished. Firm union occurred between the pubic bones, and the gait is perfectly natural. No attempt was made to correct the epispadias, this being deferred until the patient is older.

Six months later Dr. Richmond kindly wrote : " You will be glad to know that the boy you operated on is very much better. He has much more control and can attend school without any inconvenience."

Later he is reported to have gained almost complete control of the bladder.

CIRCUMCISION

Trivial as this operation seems, it is so important, especially in adults, to secure speedy healing, that it will be briefly alluded to here.

Indications. This operation is still not practised often enough, especially amongst poorer patients, and many practitioners still treat phimosis as a matter of but little importance. Hospital surgeons have, only too often, opportunities of seeing the following results follow from the above course : (*a*) Balanitis and adhesions. (*b*) Paraphimosis, from the forcible retraction of a phimosed prepuce. (*c*) From the impediment to micturition, urethral and vesical irritation, and even cystitis, may be set up, simulating the symptoms of stone. (*d*) Hernia and prolapsus recti. (*e*) The sexual feelings too early induced, and bad habits. (*f*) Impediments to intercourse. (*g*) Intensified gonorrhœa, chancres, &c. (*h*) Epithelioma.

Operation. This may be performed in many different ways, but the following points must be remembered in every case : (1) To remove enough of the mucous layer of the prepuce. If this be not done, some tension on the glans remains, and this leads, especially in adults, to troublesome erections which interfere very much with the process of healing ; later on some degree of phimosis is certain to persist. (2) Not to leave too much tissue about the frænum.

Sir Henry Howse [1] has drawn attention to the fact that the cellular tissue at this spot is loose, and that the presence of the frænal artery makes

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[1] *Guy's Hospital Reports,* 1873, p. 239.

probable the gathering of blood and inflammatory effusion at this spot In children this is a matter of less importance, but in adults it may lead to the formation of a tediously persistent lump, interfering with the function of the organ.

(3) Not to remove too much of the prepuce. Thus it is always well, in adults especially, to leave enough to cover easily the sensitive papillæ with which the corona abounds. Again, in the diminutive penis of fat infants it is very easy to remove so much as to nearly flay the body of the organ.

The following is a very simple mode of operation : The prepuce having been separated as much as possible from the glans with the finger and thumb, or a stout probe, a pair of dressing-forceps is lightly placed on the penis a little in front of the corona ; the glans being next allowed to slip back, the forceps are closed, and all the prepuce in front of the instrument is cut off with a sharp

Fig. 311. *a, b,* Shows the line of incision by which the prepuce is removed. *c.* The point of constriction of the mucous membrane which causes the phimosis. The finer dotted line shows the mucous membrane lining the prepuce and covering the glans. (Davies-Colley.)
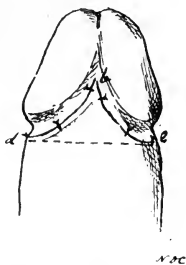
Fig. 312. The pointed process of skin (*b*) shown adjusted in the angle left by the remains of the frænum. The dotted line (*b, d, e*) shows the edge left on the skin and the trianglar bare surface which has to heal by granulation unless precautions are taken to preserve the triangular flap of skin as directed above. (Davies-Colley.)

scalpel used with a rapid sawing movement. The following directions given by the late Mr. Davies-Colley [1] are worth remembering at this early and most important stage of the operation : " The incision should begin upon the dorsum, at a point corresponding to that part of the glans which is half-way between the meatus and corona. The incision should be made downwards and forwards, so as to leave a sharp point in the middle of the under-surface (Figs. 311, 312). The object of this pointed projection is to fill up subsequently the triangular interval, which is otherwise left when the portion of the mucous membrane of the prepuce, to which the frænum is attached, is removed. The blades being at once removed, the mucous membrane is then slit up with a director and scissors or a sharp-pointed bistoury,[2] this incision running up to, but not beyond, the corona. The mucous membrane, if still adherent, must be peeled in two flaps from off the glans, this detachment being best effected by the finger and thumb, or by a stout probe swept round. The cut edges of the prepuce are then rounded off with scissors, which follow the curve of the glans as far as the frænum. Just a frill of mucous membrane, and no more, should be left all the way round the corona

[1] *Guy's Hospital Reports,* 1892, p. 164.
[2] It is well at this stage to make tension on the loose prepuce with two pairs of dissecting forceps, and thus secure a clean section.

(Fig. 311). Enough prepuce should be left to cover over the corona-papillæ, and to admit of easy stitching." All bleeding must be stopped, especially in adults, or extravasation of blood in the loose connective tissue leads to tension, cutting through of sutures, and sloughing. By drawing the skin backwards with the left hand, the bleeding arteries are exposed, picked up with forceps and tied with fine catgut. This systematic search for and tying of the bleeding-points saves much possible trouble and annoyance from reactionary hæmorrhage. The frænal and the two dorsal arteries usually have to be tied. Fine needles should be used, and catgut sutures passed quickly through skin and mucous membrane with a stabbing movement, and without bruising the edges with forceps. In passing the sutures any bleeding-points must be transfixed, and the abundant cellular tissue kept in its place with the point of a probe. This cellular tissue must on no account be cut away, as in it run the vessels to the prepuce. The frænum is now attended to, the prepuce which is still attached here being cut away carefully by **V**-shaped cuts, pointing forwards, and leaving just enough flaps to carry the sutures, and no more.

I much prefer interrupted sutures of catgut for circumcision, one or two of which can be removed, if needful, without interfering with the rest. The majority soften away. A continuous suture constricts the penis when erection occurs and is very uncomfortable.

Fig. 313. The penis after the edge of skin has been sutured to the frill of mucous membrane left along the corona. (Davies-Colley.)

One of the following dressings will be found the best : A strip of dry aseptic gauze is wrapped round the wound at the operation, for this stops any hæmorrhage well. A pad of antiseptic wool is then placed over the penis and kept in position by the pyjamas, or diaper. This protects the sensitive glans and the wounded penis from injury and irritation. The dressing is removed in a warm bath after two days, and then replaced by an aseptic gauze strip smeared with boracic ointment. This is very comfortable, and is easily removed in a warm bath without causing any pain. Any dressing is apt to get soaked with urine, and should be replaced daily or oftener in infants. When the parts are at all swollen, or where erections are likely to be troublesome, I prefer boracic acid dressings, two layers of boracic acid lint, wrung out of an iced saturated solution of the lotion. The deeper layer has a hole cut to allow of micturition, and is only removed by the surgeon ; the outer one envelops the whole penis, and may be removed and rewetted by the patient, though usually it is sufficient for him to keep it wet by dropping on a little lotion from time to time. For children I do not like a gauze dressing saturated with either collodion or tinct. benzoin., for both are irritating, also painful to remove. Urine generally soaks under them after a day or two and decomposes between the glans penis and the crusted dressing. Erections are frequent and painful with these unyielding applications. For these bromide of potassium gr. xxv with tincture of hyoscyamus ℳ xxx should be given to an adult in the evening and repeated if necessary.

After circumcision the patient should rest as much as possible. Thus

an adult should stay in bed for forty-eight hours and keep on the sofa for a week, alternate stitches being removed at intervals. If he insist on getting about too early, he must run the risk of the parts remaining long œdematous and tender.

AMPUTATION OF THE PENIS

Indication. *Epithelioma of Penis.* I would refer my readers to the remarks made in vol. i on the pre-cancerous stage in epithelioma of the tongue. Though epithelioma of the penis is much less common, lives are here also too often lost by allowing the case to go beyond this stage. Any suspicious excoriation, ulceration, or wart should be early destroyed with the acide nitrate of mercury, or excised, and the base of any wart removed should be examined microscopically. Where, after this treatment, satisfactory healing does not take place, early and thorough removal of the part should be performed. There should be no dangerous waiting because the surgeon is unable to satisfy himself whether the case is one of inflammatory induration or infiltration from new growth. In such cases, especially where there is a doubtful history of syphilis, much valuable time has been often lost with drugs, which, even if the lesion does date back to some long-past syphilis, are quite useless if epitheliomatous ulceration has set in. Furthermore, the longer ulceration continues, the more extensively will the inguinal glands be involved. In such cases, though the penis may be satisfactorily operated upon, disappointment will speedily follow, owing to the outbreak in the inguinal regions. Scarcely any surgical case presents a close more distressing, both to the patient and those around him, than one of breaking down of epitheliomatous glands, owing to the hideous ulceration, the noisome discharge, and the steady decay of bodily strength.

In a very few cases, when the disease commences around the meatus, it may still be possible to remove the affected part without interfering with the body of the penis. It seldom happens, however, that we see the case early enough for this, and it is usually necessary to remove the whole of the glans and more or less of the corpora cavernosa. Before doing this the prepuce, unless it admits of being retracted, should invariably be laid open, so as to expose the growth and make quite sure of its real nature. The parts should be cleansed, as far as possible, by shaving the pubis and applying fomentations to the penis for two or three days before the operation. When the patient is anæsthetised, the surface of the growth is seared with the thermocautery to avoid septic and malignant infection of the wound.

Operations. (1) *Circular Amputation.* This gives good results, though not equal, in my opinion, to those which follow the flap method. The vessels being commanded by a rubber tubing used as a tourniquet, the skin is drawn a little forward to prevent any superabundance afterwards, and the amputation is effected by a single sweep of the knife. The vessels and the urethra are treated as directed below.

(2) *Flap Amputation.* This method was followed by rapid healing, and gave an excellently covered stump in the eleven cases in which Mr. Jacobson made use of it. Hæmorrhage having been provided against by one of the above-given means, the surgeon enters a narrow-bladed knife, at a point well behind the disease, between the corpus

spongiosum and the corpora cavernosa, and then cuts forwards and downwards for about three-quarters of an inch. From this small inferior flap the urethra is dissected out. A flap of skin is now cut from the dorsum and sides of the penis, resembling in miniature the upper skin-flap in amputation of the thigh. This flap being held back, the corpora cavernosa are divided vertically upwards on a level with the point of transfixion. Any vessels which can be seen are now tied with catgut. On removal of the tourniquet, and securing any spirting vessels, free oozing often takes place from the corpora cavernosa, but it ceases spontaneously. All hæmorrhage being arrested, the upper flap is punctured, and the urethra drawn through the face of the flap, slit up, and stitched *in situ*. The two flaps, upper and lower, are then united by a few sutures.
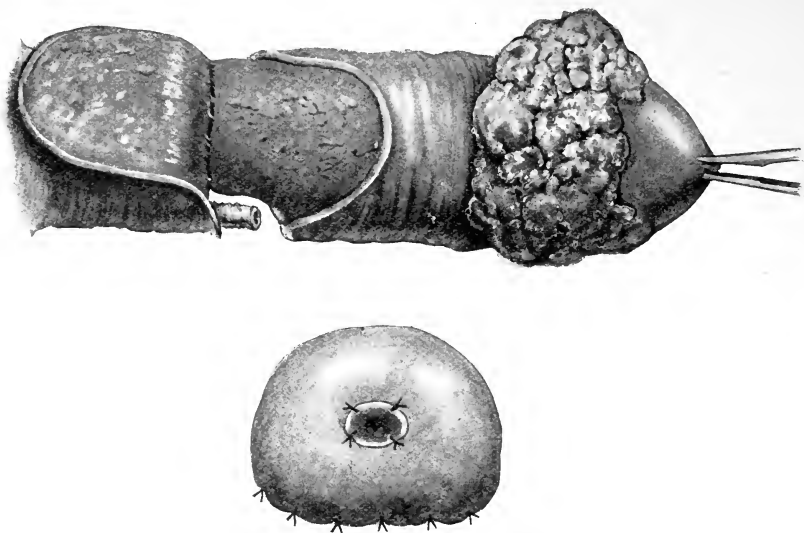
FIG. 314. Flap amputation of the penis. The appearance of the stump, with the urethra slit up and stitched *in situ*, is shown above.

This method secures a natural skin-covering for the severed corpora cavernosa, and prevents the delay and irritation which healing by granulation entails. A similar operation was long ago suggested by Prof. Miller, of Edinburgh, but this surgeon cut his flap from below. If, as Mr. Jacobson recommended, the flap is taken from above, the skin will be found to fall into position more readily over the raw surfaces of the corpora cavernosa. After all these operations the patient should pass a short piece of bougie at regular intervals.

(3) *Removal of the entire penis and its crura* is occasionally necessary.

Thus, where the penis is involved as far back as the scrotum, the entire penis should be extirpated, if the inguinal glands are not seriously involved, and if the powers of repair are satisfactory. The patient being in lithotomy position, the scrotum is to be split deeply along the whole length of the raphé, and the corpus spongiosum carefully dissected out. This step may be facilitated by passing a large sound. When the triangular ligament is exposed the above instrument is removed,

and the corpus spongiosum which has been dissected out is cut through, enough being left to bring out in the perineum (*see* Fig. 315). By means of a blunt dissector, the crura are then detached on either side from the pubic arch, and, the incision being prolonged around the penis above, the suspensory ligament is divided, and the dorsal arteries secured. The cut end of the corpus spongiosum is now slit up and stitched in the posterior part of the scrotal incision, and all the rest of the wound closed by sutures, a small drainage-tube being inserted a little in front of the urethra. Similar operations to the above have been performed on several occasions, but the important modification of dissecting off the
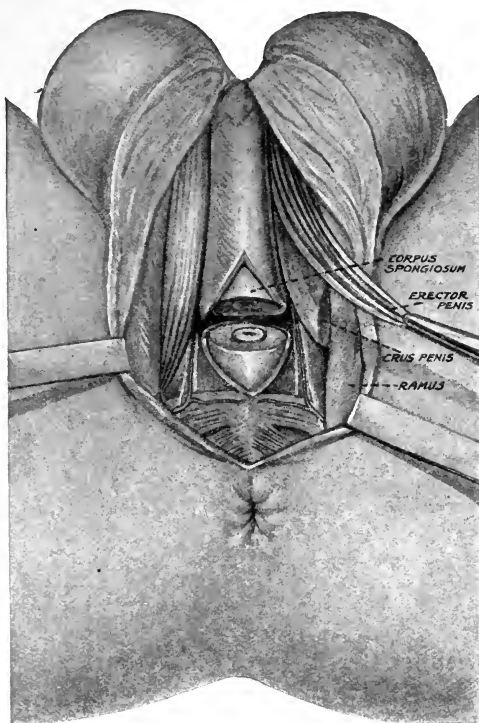
Fig. 315. Removal of the entire penis and its crura. The accelerator urinæ and erector penis have been divided on the left side, and the corpus spongosium and urethra have been severed a little in front of the bulb.

crura, and thus ensuring complete removal of the cancerous organ and its capsule, was brought before the notice of English surgeons by Sir Pearce Gould [1] (*see* Fig. 316).

In most cases of amputation of the penis the patients will be wise in consenting to castration—an operation which will add in many cases largely to their comfort, and at a very slightly increased risk. [2]

Question of removing Enlarged Glands. These should always be extirpated at the same time as the amputation of the penis, together with as much of the lymphatic vessels and surrounding cellular tissue as possible, preferably in one piece in order to avoid the escape of cancer

[1] *Lancet*, May 20, 1882, p. 821.
[2] Wheelhouse, *Brit. Med. Journ.*, 1886, vol. i, p. 187.

cells into the wound. As long as the glands are involved by growth only, hard and separate from each other, it will be comparatively easy to accomplish this, and thereby add materially to the prolongation of the patient's life. But where they contain not only secondary deposits, but also inflammatory matter, owing to ulceration having set in at the seat of the primary lesion, satisfactory removal of the glands is always a matter of great difficulty and often impossible, owing to their softness and tendency to break down, to their adhesions to their capsules, and the matting of these to the surrounding parts, the vascularity of which is increased, and tendency of the overlying skin to become adherent. When the growth becomes adherent to the femoral or iliac
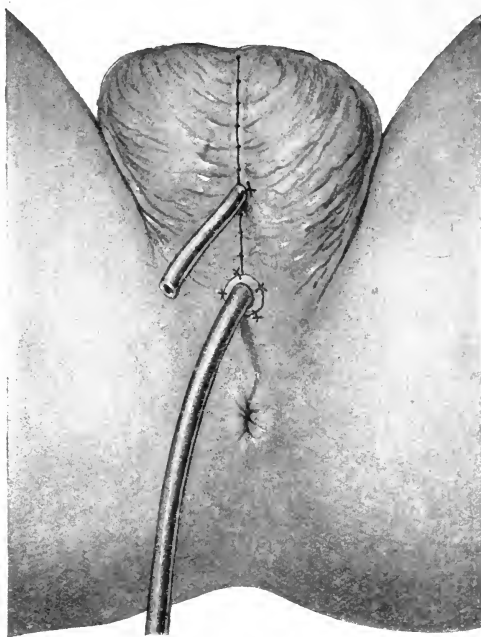
Fig. 316. Removal of the entire penis. The posterior tube drains the bladder through the urethra ; the anterior tube drains the large space left after removal of the penis.

vessels, no attempt should be made to remove it, for the main vein may have to be sacrificed, with resulting œdema of the leg. The removal is very likely to be incomplete, and to be quickly followed by recurrence and hæmorrhage.

In all such operations especial care should be taken to ensure asepsis, and to avoid laceration of the tissues.

Antiseptic dressings are the safest to use in this region.

RADICAL CURE OF HYDROCELE.[1] VARICOCELE. ANASTOMOSIS
OF THE VAS DEFERENS. CASTRATION. ORCHIDOPEXY

RADICAL CURE OF HYDROCELE

IN a paper written nearly forty years ago,[2] Mr. Jacobson drew attention
to the uncertainty of the radical cure of hydrocele by iodine injection
as usually practised. Thus, out of 44 cases treated with solutions of
iodine and potassium iodide at Guy's Hospital, he found that the treat-
ment failed in 8 cases, and that in 2 it failed twice.

With the great strides that have been made towards the perfection
of aseptic surgery, injection of irritants has become less and less common,
so that at the present time it is rarely performed. Under aseptic con-
ditions excision of the parietal part of the sac is no more dangerous than
injection, and it is far more certain to cure. Moreover it is no longer
necessary to use a general anæsthetic in all cases, for safe and efficient
local anæsthesia suffices when the former is contra-indicated or declined.
There are still many elderly patients, however, who wish for nothing more
than the temporary, and sometimes prolonged, relief that simple tapping
affords. Others decline all cutting operations. In them, and under
circumstances which are unfavourable for resort to radical operations,
injection may still be tried, and therefore a description of this method
is retained in this book.

I. **Partial Excision of the Sac.** This latter is often spoken of as
excision of the tunica vaginalis. As the parietal layer of the serous
membrane can alone be removed, I prefer the above title.

This is by far the most certain method of cure. While it is right to
remember that no method can be absolutely relied upon as radical, and
that hydroceles have recurred even after incision and partial excision
of the sac, there can be little doubt that this must be extremely rare,
since after efficient removal of the parietal layer of the tunica vaginalis the
cavity must, with very few exceptions, be entirely obliterated. A method
which removes a large part of this secreting surface must à priori be
surer than those methods which do their work, as it were, in the dark,
in which the drainage must needs be imperfect, the quantity of the
irritant employed necessarily limited, it being thus always left doubtful
how far the injection has been weakened by dilution or chemical change,
and how far folds of the inner surface of the tunica vaginalis have escaped

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[1] The methods of injection given below to hydrocele of the tunica vaginalis and
to encysted hydrocele. Antispetic incision and partial excision of the sac are applicable to
all varieties of hydroceles, including the congenital.

[2] *Lancet*, September 1, 1877.

inflammation at all. On this account I prefer to make use of partial excision in all cases where the general condition of the patient is satisfactory, and where he is willing to rest for a short time.

The **cases** to which this method appears to me to be **especially suitable** are those where (*a*) iodine or carbolic acid has failed; (*b*) where the sac is very large or has very thick walls. (*c*) Where the patient is young and healthy and a radical cure is desirable, and especially where radical cure is demanded before the patient can enter one of the public services. (*d*) Where the surgeon is desirous of exploring the sac of the tunica vaginalis, as in cases where enlargement of the testis of a doubtful nature coexists with hydrocele, and does not yield to ordinary treatment, where a hæmatocele has supervened on a hydrocele, or in the much rarer cases of loose bodies in the sac of the tunica vaginalis. (*e*) Where several hydroceles co-exist, *e.g.* either double hydrocele of the tunica vaginalis, or a vaginal and encysted hydrocele. (*f*) In certain cases of hydrocele complicated with hernia, *e.g.* (1) in young subjects, where a radical cure of both is desired; (2) in much older patients, where the hernia is irreducible, where, especially in unhealthy patients, there is a risk of the inflammation set up by the injection extending to the sac of the hernia. (*g*) In cases of congenital hydrocele an operation is usually desirable when spontaneous cure does not take place; a truss fails to obliterate the communication with the peritoneal cavity. And the same course will be wise in the case of encysted hydroceles of the cord.
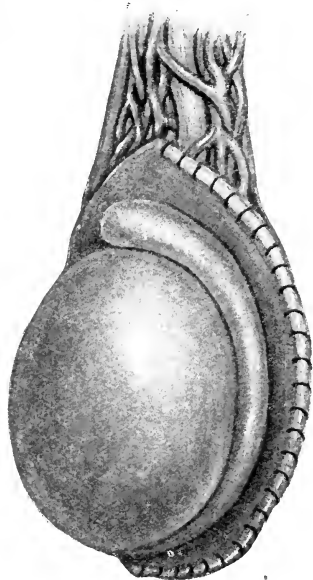
Fig. 317. Excision of parietal part of tunica vaginalis. The cut edge often bleeds freely and to control this a continuous catgut suture is inserted. The edge is really quite close to the epididymis.

Operation. While an assistant pushes the hydrocele up towards the groin an incision three inches long is made over the corresponding external ring and the upper part of the cord. The divided external pudic vessels are secured and tied. The coverings of the tunica vaginalis are incised until the latter, which is very mobile within its coverings, projects into the wound. It is opened and as the liquid escapes the edges of the opening are cleanly picked up with forceps. When these are accurately picked up without any of the coverings, the parietal layer of the tunica vaginalis can be very rapidly and easily separated from its coverings by gauze dissection without appreciable hæmorrhage. The separation is carried close up to the epididymis on the outer, and to the back of the testicle on the inner side. Along these limits it is snipped away with curved scissors, and forceps are applied to all bleeding-points which are tied or sewn over with catgut in order to arrest all hæmorrhage. No flaps of tunica vaginalis are left for future pocketing. During the separation the testis is drawn out of the wound. The epididymis is examined carefully for cysts, which are not uncommon about the globus major. If any of these

or hydatids of morgagni are found they should be removed and all bleeding arrested. The testicle is replaced in the scrotum, care being taken to avoid rotation of the cord. The wound is closed with interrupted sutures.

Mr. Lockwood recommends that in cases where the origin is doubtful, or where the hydrocele is large and of long standing, and the testicle may be wasted, it is wise to obtain permission beforehand to remove the testis.

In some cases it is wise to leave a temporary drain in the lower part of the wound, for otherwise a hæmatoma may follow the removal of a large hydrocele. Recurrences after this method are very rare. Aseptic dressings are secured in place by firm and even bandaging with a double spica. While this is applied care must be taken that the scrotum is kept well up. This is a cardinal point, and must be attended to not only now, but later on, at and after each dressing. It prevents œdema, bagging, and inflammation, and thus also pain, and hastens rapid repair of the wound. By the fifth or seventh day the patient may get on to a sofa, and by a date varying from the tenth to the fifteenth day he may usually begin to get about with a suspender.

Hydroceles of the canal of Nuck and encysted hydroceles of the cord are best excised if they give rise to pain or inconvenience. Encysted hydroceles of the epididymis rarely attain a size large enough to cause much trouble. When they do they may be excised, care being taken to remove the whole sac. No operation is to be undertaken for the multiple small cysts that form in some elderly men as a degenerative change.

II. **Eversion of the Tunica Vaginalis** (Jaboulay). Under local or general anæsthesia, the tunica vaginalis is exposed anteriorly, and incised sufficiently to allow the testicle to be brought out. Traction is made upon this organ while the scrotum is held. Thus the tunica vaginalis becomes completely everted, so that its serous surfaces face outwards. It is secured in this position by means of two or three catgut sutures, which are passed near the edges, which are now posterior and surround the spermatic cord. Care must be taken that the stitches do not compress or injure the cord. Sutures are not always necessary when the opening into the tunica vaginalis is made only just large enough to allow the testicle to be prolapsed. The testicle is then replaced in the scrotum and the wound closed. The endothelial surface of the serous sac now faces the scrotal fibrous and areolar tissues, to which it generally becomes adherent in a short time, and any temporary serous effusion is drained away by the lymphatics of the scrotal coverings.

At first it was considered to be necessary to shell the unopened tunica vaginalis and the testicle out of the scrotal coverings, in order to obtain proper eversion, but this step is superfluous, and is attended with more or less hæmorrhage.

This ingenious and simple operation is not so successful as might be imagined, for recurrence has followed it, and a serous sinus has persisted. In other cases the cord has been injured or seriously compressed. But Major Fullerton tells me that it is frequently and successfully used in India.

Longuet records twenty-two cases without recurrence, and Dudley Tait [1] records three cases. It is not stated how long these patients were observed. The operation has not found much favour in England, because

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[1] *Ann. of Surg.*, 1901, vol. xxxiii, p. 305.

excision of the parietal part of the tunica vaginalis is a more certain radical procedure. In view of the comparative simplicity of the operation, however, it is worth trying for some thin-walled hydroceles.

III. **Injection of Carbolic Acid.** This method was introduced in 1881 by Dr. Levis, of Philadelphia.[1] The following *advantages* have been claimed, and in my opinion largely substantiated : (*a*) It is less painful than iodine. (*b*) It is more certain. Thus carbolic acid produces almost uniformly the proper degree of inflammation, neither falling short of nor exceeding that needful for producing plastic lymph. (*c*) There is less risk of sloughing. (*d*) The patient is only kept from his employment for a day or two, and sometimes for a shorter time than this, or even not at all.

While the above advantages of carbolic acid injection over that by iodine, especially the fact that it entails a much shorter rest and absence from business, have, in my opinion, been largely substantiated, it is certain that complications and undesirable sequelæ, while less frequent, are not so entirely uncommon as some partisans of this method would have us believe. (1) **Recurrence.** With regard to this matter, I would point out that a large number of cases have been published as radical cures within a year or so of the first introduction of the method. Thoughtful surgeons who have seen much of radical cure of hydroceles will not need that I should refer them to the remarks which I have made on the rebellious nature of many hydroceles, and how they must be carefully watched for an extended period before a radical cure can really be claimed. It is beyond the bounds of probability that while a hydrocele will recur after careful incision and drainage, and even after incision and partial excision of the sac, injection of carbolic acid will be invariably and permanently successful. And it is interesting to note that in America itself, where this method has been most largely used, and where surgeons have had the largest opportunities of watching its results, they are not in entire accord as to its value.

Thus Dr. Bull, of New York,[2] in a paper recommending antiseptic incision writes : " It is a striking fact that, of the 13 cases I have met with, 2 had been treated unsuccessfully in this way. As it attempts a cure by the same process as that incited by iodine, an adhesive inflammation, I see no reason to believe that it will ever yield much better results." Dr. R. F. Weir, in the discussion that followed on the reading of the above paper, said he had used carbolic acid injections over sixty times. Occasionally relapses had occurred, not in a large proportion, however, as he could recall only four or five instances, and in those the patients were cured by a repetition of the same treatment. In three of those the injection was repeated too soon, as subsequent experience showed that a longer delay would probably have resulted in a cure. Helferich, of Griefswald (*Therap. Monatsschrift*, 1890), has tested carbolic acid injection by Levis's method in over 30 cases, with known results in 27 ; 21 were cured, 6 relapsed, all of these latter, save one, being cured by a fresh injection.[3]

(2) **Much Reaction. Cellulitis and Suppuration.** It is right to say that in some of the cases in which these have followed on the injection of carbolic acid an excessive quantity seems to have been employed. Thus

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[1] *Boston Med. and Surg. Journ.*, 1881, vol. cv, p. 540.
[2] *Ann. of Surg.*, July 1886, p. 35.
[3] Mr. Southam (*Lancet*, 1887, vol. ii, p. 515) mentions a case which recurred within a month of the injection with carbolic acid, and was then treated by antiseptic incision and partial excision of the sac.

Dr. R. Abbe [1] reports that he injected three drachms of carbolic acid and glycerine into a large hydrocele sac, and that acute suppuration followed, requiring incision, which cured the hydrocele. He allows that the above quantity is excessive, one drachm always sufficing. Dr. Weir,[2] in one case in which the iodine treatment had failed, injected three drachms of carbolic acid ; this was followed by the usual absence of pain, but with recurrence of the swelling in a few days, which went on to suppuration, and after incision of the sac shreds and large masses of membrane were discharged, gangrene of nearly the entire tunica vaginalis being produced.

(3) **Carbolic Acid Poisoning.** Most writers have distinctly stated that this does not occur. It is certainly extremely rare, as it is probable the surfaces are sealed by the carbolic acid.

But Dr. J. Murphy, at a discussion at the New York Association,[3] said he had known of three or four cases in which carbolic acid used in this way was followed by bad effects, especially on the kidneys. He had seen one case terminate fatally, and he could not attribute this death to anything but carbolic acid poisoning. He did not know how much carbolic acid was used. I know of one case of death from pulmonary embolism a few days after injection of carbolic acid. Hæmorrhage into the sac may also occur.

The Injection. After the usual tapping Dr. Levis, by means of a syringe which has a nozzle sufficiently long and slender to reach entirely through the cannula, injects about *a drachm (of crystals) of carbolic acid*, which must be kept liquid by a 5 or 10 per cent. addition of glycerine or water. No more fluid is to be used for dilution than is absolutely necessary. The ordinary Liquor Carbol. Liquefactum answers well. As soon as the carbolic acid is lodged in the sac the scrotum is freely manipulated, so as to diffuse the carbolic acid uniformly. A sense of warmth is produced, quickly followed by decided numbness.

My own experience is too limited to be of any value. Of late years I have used partial excision of the sac, and have been so well satisfied with it as to prefer to use it wherever the patient can lie up. But where this is objected to, I have used iodine and carbolic acid, but the latter only in eleven cases. None have recurred to my knowledge, and some have been watched for over three years. There is no need of Levis's special instrument. What is essential is to use carbolic acid liquefied with glycerine, not to inject more than one drachm, and to lodge it well within the tunica vaginalis. This may be done by means of one of the large exploring hypodermic needles, which hold 60—100 minims.[4]

The needle attached to the syringe is first lodged safely in the cavity of the hydrocele, which is then tapped in the ordinary way with a fine hydrocele-trocar. When the sac has been thoroughly emptied, the cannula is withdrawn, and the syringe, previously cleansed, containing the solution must be screwed on to the needle, which has been kept in situ and the solution injected. However this is done, the carbolic acid must be brought in as complete contact as possible with the interior of the sac by manipulating the scrotum, turning this from side to side,

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[1] *New York Med. Journ.*, December 22, 1883.
[2] *Loc. supra cit.*
[3] *New York Med. Record*, June 20, 1891.
[4] I learnt the value of these in small hydroceles, as in those of the cord, or the infantile variety in boys, from the late Mr. Berkeley Hill (*Brit. Med. Journ.*, 1886, vol. i, p. 1164). Following Mr. Hill, I have also given an anæsthetic in children.

upside down, &c. I have employed strapping or suspension with cotton, wool packing later, as after the use of iodine.

VARICOCELE

Indications. While palliative treatment will be sufficient in the great majority of cases, if, at the same time, due attention is paid to the general health, the occupation and habits of the patient, and, where this is required, to his sexual hygiene, an **operation** will be **justifiable** in the following cases :

(1) Where the patient is precluded from entering one of the public services, or any occupation involving much activity in the upright position. Thus, out of the 28 cases in which I have operated, 12 were private cases, of which 9 were applying for and passed into the army or navy, and 1 was a medical man, operated upon for double varicocele ; of 16 hospital cases, 1 was desirous of entering the police and subsequently did so ; 1 was a goods-guard on probation, and found that a large left-sided varicocele threatened to spoil his prospects, the aching pain, which invariably followed the jumping in and out of his brake van, being only relieved by the patient's lying down, and being inevitably brought on again by the next station. This man stopped me on London Bridge some five years after to say that he was in regular employment as a goods-guard, married, and the father of two children. Five others were shop assistants, and two were gardeners. (2) In any case where the varicocele persists or steadily increases, in spite of treatment, and where it is accompanied with much distress, annoyance, or pain, or where it interferes with some justifiable pursuit, such as riding ; (3) where the patient is going to reside in a hot climate, where a small varicocele soon enlarges from want of support from the atonic cremaster and dartos ; (4) where the surgeon has satisfied himself that the testicle is undergoing atrophy ; (5) where the varicocele is accompanied by frequent seminal emissions and much mental misery. In the two last given indications, great caution must be shown before operation is resorted to, and the last is the most doubtful of all. Where the patient is clearly a hypochondriac, or a monomaniac in genital matters, no operation is, of course, to be thought of. It is certain to be a failure.

The choice of operation is a very large one, but as I consider that one alone has been proved to be alike efficient and simple, I shall not occupy my space with an account of any others, or with the history of the operation. Like so much else in operative surgery, the only efficient and simple operation for varicocele dates to the great discovery of Lord Lister.[1]

Excision. This operation, performed with the parts well in sight, has the very great advantage of allowing the surgeon to carry out each step with precision, to include what he thinks safe, and no more ; it does away with the risk of transfixing a vein, and its possibly disastrous results of septic thrombosis ; while Lord Lister's teaching has enabled us to perform it without the risks of hæmorrhage, cellulitis, and blood-poisoning, which were so terribly frequent in operations on veins performed before his day.

The parts are shaved and thoroughly cleansed with soap and water,

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Sir Henry Howse drew attention to the method of aseptic excision in varicocele (*Guy's Hosp. Reps.*, 1887, vol. xxiii, p. 408).

and after being thoroughly dried they are sprayed with tincture of iodine. The patient having been anæsthetised and the field of operation isolated with aseptic towels, the assistant makes the veins prominent by grasping the root of the affected side of the scrotum and protruding the varicocele. The skin incision, which should be about an inch and a half long, is, made above the scrotum and in front, over the external abdominal ring. If this plan is adopted it will be found that the varicocele is quite easily pushed up into the wound, and it has the advantages of rendering the operation more convenient, whilst the wound is more easily sutured and heals more certainly and readily than one which involves the skin of the scrotum. Further, the spermatic veins are less numerous, and more easily separated from the vas, than lower down, and the tunica vaginalis is very unlikely to be opened. The exposed skin around the
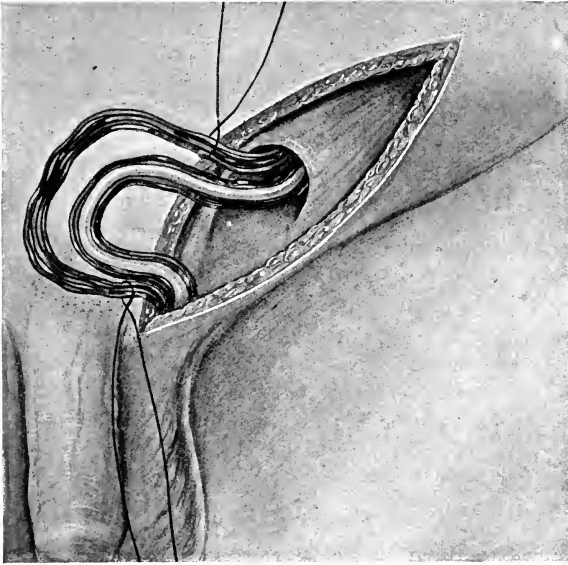
Fig. 318. Operation for varicocele. Incision in the groin over the external ring. Some veins are left in front as well as behind the vas deferens.

wound is covered with aseptic lint, which is fastened to the edges of the wound with tissue forceps, so that neither instruments nor sutures touch the skin.

With one or two strokes of a keen-edged scalpel the packet of veins is exposed and is then carefully opened. The surgeon then passes a director through the packet so as to leave less than a third of the veins behind it. This gap is enlarged, and the anterior bundle of veins is separated by gauze dissection, from the external ring to the testicle. The bundle is crushed with forceps and tied with fine catgut near these two points, care being taken to avoid the coil of the vas in placing the lower ligature. One end of each ligature is left long, and these ends are tied together so as to bring the two stumps together. The object of this important step is to shorten the cord permanently, and to restore the natural suspension of the testicle. All bleeding vessels are tied and the cord is replaced. Another step should be taken before the close of the

operation, *i.e.* ligature and removal of any very enlarged scrotal veins, a step which I always adopt when the patient's attention has dwelt on these. The whole wound, superficial and deep, is then carefully scrutinised, and every bleeding-point being secured is thoroughly dried. The edges of the wound are then carefully adjusted with a continuous suture of fishing gut.

Aseptic dressings are then applied, due facilities being provided for the patient's micturition. In securing the dressings in *situ*, care should be taken to keep the scrotum well up on to the pubes by bringing the turns of the spica from below upwards and not in the reverse direction. I generally change the dressings at the end of the third day, immediately after the first action of the bowels, and again at the end of the first week, to remove the sutures. At this date the patient may get on to a sofa. If the stumps of the cord have been sutured together there is much less need for the patient to wear a suspender afterwards ; but to give the operation every chance, and to save all drag and tax upon parts which have very recently united, I generally advise that a suspender be worn for three months. In addition to the support which I believe to be advisable while the sutured stumps of the cord are being firmly knit together, I am of opinion that the continuance of support to the parts for a while prevents a too rapid melting away of the little nodular mass, which, callus-like, marks the seat of the operation.

The points to which I attach most importance in the operation are maintenance of strict asepsis throughout. The careful selection of the number of veins to be removed, suturing together the two stumps, and so shortening the cord and providing for suspension of the testicle, arrest of all hæmorrhage, thorough drying out of the wound, and the careful application of the dressing, so as to keep the scrotum well up on to the pubes. I look upon these details as most necessary if rapid healing is to be made certain of, and cellulitis, epididymo-orchitis, and hydrocele prevented. It is not safe to remove all the veins in front of the vas, for this may lead to epididymo-orchitis, hydrocele of the tunica vaginalis, or even atrophy of the testicle from interference with the blood, lymphatic and nerve-supply of the testicle.

The **chief risks** and **causes of failure in the operation** are as follows :

I. **Sepsis and its Results.** The risk of these was always present with the old subcutaneous operations, however modified. It is by no means to be lost sight of with the open operation performed with the advantages of modern surgery. The operation, although it may appear to be trivial, is not one to be undertaken lightly, and it should not be performed except under aseptic conditions, lest cellulitis, septic thrombosis, or even sloughing of the testis occur. Short of these catastrophes, suppuration around the ligature may occur unless catgut is used instead of silk, and the precautions already mentioned are observed. A troublesome stitch sinus results, and frequently a hydrocele of the tunica vaginalis develops in such cases. I have seen several patients who have had to submit to a radical operation for hydrocele, the sequela of excision of varicocele.

II. **Inclusion of too many Veins.** That this is a real danger is shown by a case which Mr. Jacobson published.[1] A transient hydrocele may develop from removal of too many veins, but a permanent hydrocele is very rarely seen apart from a definite history of stitch abscess.

[1] *Syst. of Surg.*, vol. iii, p. 571

III. **Atrophy of the Testis.** This may occur from destruction or injury of the sympathetic nerves of the testis, which run with the vas. In order to avoid this rare sequela, care must be taken to leave the vas well alone ; it is not necessary to touch it at all.

IV. **Division or Laceration of the Vas Deferens.** This has happened to careless operators more commonly than would be suspected from publications. Atrophy of the testis does not occur if the injury is limited to the vas deferens. The accident is most likely to happen from want of care in separating the lower coiled part of the duct from amongst the bulky mass of veins near the epididymis.

V. **Recurrence of the Varicocele.** I am of opinion that if operation-cases were more thoroughly followed up afterwards, this sequela would be found to be more common than is thought to be the case. To prevent this risk of recurrence Sir W. M. Bennett lays stress on the need of removing the entire plexus of spermatic veins. As I have been unfortunate enough to meet with a case in which, in spite of care taken, too many veins were ligatured and removed, I cannot agree with Sir Wm. Bennett. Another instance of what appears to be recurrence, but which is really an escape of the upper part of the spermatic plexus, may be due to the upper ligature being applied too low down (Bennett). In this case the part of the plexus between the upper ligature and the external ring remains full, and may give trouble for a time, though it gradually shrinks.

Insecure knotting of the ligature, or not using reliable material,[1] may, of course, lead to recurrence after any method in which ligatures are used, but the veins are not also divided. It may be truly said that the accidents and sequelæ mentioned above are avoidable by careful and aseptic operating, but the danger of their occurrence is still real enough to justify the warning that this apparently simple operation is not to be performed without due care, and under circumstances which are favourable for aseptic work.

ANASTOMOSIS OF THE VAS DEFERENS

A divided vas deferens may be anastomosed by slitting the distal cut end for about an inch, so that two flaps are formed by two incisions, one on each side of the vas. One of these incisions is then carried up a little further (half an inch), and the obliquely pared testicular end of the duct is then laid in contact with the lumen of the urethral part, and secured with very fine catgut sutures. The equal tails of the urethral end are then wrapped round the testicular part of the vas, and sutured in position. Layers of fascia are then wrapped round the anastomosis and fixed in position by sutures.[2]

Lydston[3] passes a thread of silkworm gut into both ends of the vas, and brings one end of the thread out through the side of the proximal part of the tube, and later through the skin. The ends of the vas are brought together by two catgut sutures, and the anastomosis is reinforced by folding the " sheath of the cord " around the vas and securing it in apposition by means of a continuous catgut suture. The silkworm-gut thread is removed after ten days.

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[1] Mr. Bennett prefers kangaroo-tail tendon ligatures.
[2] Lynn Thomas, *Brit. Med. Journ.*, 1904, vol. i, p. 13.
[3] *Ann. of Surg.*, vol. xliv, p. 92.

CASTRATION

Indications. I. *Growths of the Testicle.*

Varieties. The conclusions of Nicholson [1] upon this subject are valuable.

" (1) *Spheroidal-celled carcinoma*. This is in nearly every case an encephaloid cancer. It may be alveolar or non-alveolar. It is often mistaken for a sarcoma. It may occur at a young age, and runs a clinically malignant course. Next to embryoma, it is the commonest form of new growth.

" (2) *Sarcoma*, which is usually, if not always, composed of round cells. It occurs at a somewhat earlier age than does carcinoma and is even more malignant. It occurs far less frequently than is generally supposed. In young patients it may be bilateral.

" (3) There is evidence to show that carcinoma disseminates mainly by the lymphatics, and sarcoma by the blood-vessels.

" (4) *Endothelioma*, which may arise in the endothelium of the blood-vessels or lymphatics. It occurs usually in young adults, but may do so at any age. Although it generally runs a benign course, it may be very malignant, and produce secondary deposits in the lymphatic glands.

" (5) *Embryoma*, which can be shown to contain structures derived from the three blastodermic layers of the embryo. It is the commonest new growth of the testicle, but it is often overlooked. Although not necessarily malignant, it may produce metastases composed of all the tissues of the primary growth. Or one tissue may become actively malignant, in which case the deposits will be formed of that tissue alone."

Diagnosis of Malignant Disease of the Testis. As the records of surgery contain many instances of mistakes under able hands—hæmatoceles removed for malignant disease, and malignant disease opened for hæmatoceles—a few hints may not be out of place here on the subject of castration.

Contra-indications. Castration should not be performed when the cord is extensively involved, when masses can be felt deep-seated in the iliac fossa and lumbar region, where there is any evidence that the liver or lungs are involved, or when the jaundiced sallow tint and rapid emaciation point to the disease having become general. In cases at all advanced, though the patient might be rid of an encumbrance, the operation would be very liable to be followed by a low form of peritonitis, or, before the wound was healed, swelling would probably appear in the inguinal region, and the growth soon fungate through the wound.

The following are the points on which most reliance may be placed :

Continuous, and often quickly progressing, solid enlargement of the testicle or epididymis without inflammation. Sometimes this progress is much slower ; occasionally it may seem to be in abeyance, but careful watching with frequent examinations (and these are the key to obscure cases) will show that the enlargement is progressing in spite of treatment. Failure of well-directed treatment. Where the swelling is small, still oval in shape, and smooth and firm in outline, a brief trial of mercury or potassium iodide may be made, combined with carefully applied strapping, but where in a week there is no result, or where the case is of longer duration, and delay will very likely be fatal, an exploratory

[1] *Guy's Hospital Reports,* vol. lxi, p. 249.

incision with antiseptic precautions, followed, if need be, by immediate castration, will be the wiser course.[1] *Consistence.* This is rarely for long the same all over the swelling. Even if a firm, slow growth seem uniform and recall orchitis, a careful examination will usually find one or two spots which are more *elastic* than the rest. Usually the softening at places where cystic or degenerative changes are taking place is well marked. But it may require somewhat prolonged watching to detect one or two at first lowly rising projections or bosses which foretell that the tunica albuginea is becoming thinned at this spot. Of enlargement of the cord,[2] fulness of the scrotal veins, adhesion of the scrotal tunics, increasing aches and painfulness, I say nothing, as they are evidence that the disease is entering into a later stage.

An exploratory incision is to be preferred to the use of a trocar, as being more certain to give information. A trocar may enter a solid part or withdraw some scanty mucoid fluid. Sometimes the amount of blood which flows through the cannula of a trocar thrust into a testicle, the subject of rapidly growing malignant disease, is so great as to lead to the supposition that it must be a hæmatocele. In such cases, however, the diminution of the swelling is not so proportionate to the flow of blood as it would be in hæmatocele. Furthermore, the blood is usually bright, not dark and altered, as in hæmatocele.

Prognosis. It will be seen that the prognosis is always grave, extremely so in the softer and more rapid growths. Kocher goes so far as to say with regard to these that no case of really permanent cure of encephaloid carcinoma is known. In medullary sarcomata, especially in children, the prognosis is almost as gloomy. But while the above opinion is only too true of the majority of cases, a sufficient number have been recorded to show the benefit which may follow on castration, even in the soft forms of sarcomata. Kober collected 105 cases of sarcoma of the testis, out of which 9 were known to be free from recurrence over three years after the operation.

Chevassu collected 100 cases of castration for maligant disease of the testicle ; of these only 19 survived over four years.

Mr. Meade, of Bradford, removed, in 1846, the testicle of a patient aged 40 for a swelling which had lasted about nine months.[3] Nine years later the patient remained free from any return of the disease. In the museum of St. George's Hospital is a specimen of a testicle converted into a mass of soft malignant growth, with large caseating patches, which Mr. Cæsar Hawkins removed from a patient aged 45, the enlargement having lasted two years. Twelve years later this patient was alive, and in good health. In the *Med. Times and Gazette*, 1886, vol. ii, p. 287, a case of Mr. Cock is mentioned in which a patient remained in good health for six years after castration for " medullary cancer," being then lost sight of in consequence of his emigration to Australia.

Sir Henry Morris [4] relates two remarkable cases of carcinoma of the testis with prolonged freedom from recurrence after simple castration. One of these lived nine years and then died of secondary growth in the loin, invading the spine and causing intestinal obstruction. The other patient was well twelve years after castration.

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[1] I may warn my younger readers of the temporary improvement which potassium odide sometimes seems to bring about even in malignant swellings.

[2] I quite agree with Mr. Butlin (*loc. supra cit.*) that *early* enlargement of the cord is met with in inflammatory conditions of the testicle, and is here a contra-indication to malignant disease.

[3] *Lond. Med. Gaz.*, vol. xliv, p. 702.

[4] *Lancet*, 1912, vol. i, p. 634.

While these cases are most encouraging, I fear that they are exceptional. It will be noticed that in one a swelling had lasted nine months, and in another two years. If it be thought that such cases show that no limit can be fixed beyond which castration must be useless, the following must be remembered. First, is it possible that the earlier enlargement was, for some time at least, inflammatory? Secondly, as a rule, in the softer carcinomata, enlargement of the lumbar glands will be present by the end of the first year of the growth, and often earlier.

As a rule, the retro-peritoneal glands and viscera will be involved by extension and secondary deposits within six months of the time of castration. And this result is the more disappointing because the testicle, a free, floating organ, and one placed independently in a fibrous capsule, appears to be remarkably favourably placed for the radical removal of malignant disease. The intimate association of the organ with the lymphatic system, both within itself and with those within the abdomen, and the facility with which these are early implicated, handicap us terribly here.

But if, as happens most frequently, the disease recurs elsewhere after castration, a useful life may yet be prolonged; the patient, rid of a wearisome encumbrance, is made more comfortable; and towards the close death from internal deposits of malignant disease is not accompanied with the same distress both to the patient and those around him as when the disease is situated externally. In proof of the temporary benefit of castration, Mr. Curling [1] relates the case of an eminent barrister, who for two years and a half after the removal of a testicle for soft cancer was able to continue the practice of his profession to the great advantage of his family, death ultimately taking place from extension to the lumbar glands. It is possible that earlier operation with the removal of the lymphatics, vessels and glands in the loin will be attended with more success (p. 759).

II. *Tubercular Testicle.* I am of opinion that operation should be performed much earlier in this disease than is usually the practice, in order to prevent the spread of the disease along the vas deferens to other parts of the genito-urinary tract. The infection travels upwards to the vesiculæ seminalis and not in the reverse direction. [2] Early excision of the epididymis and the diseased part of the vas deferens may prevent the upward spread, but it often fails to prevent local recurrence. Natural cures are so few, dissemination is so frequent and so grave, to the bladder and kidneys, vesiculæ seminales, or prostate. Epididymectomy or orchidectomy is nowadays so safe an operation, that it should not be deferred.

III. *Syphilitic Testis.* Here, owing to the specifics which we possess, castration is much more rarely called for. The indications can readily be judged of from those above given.

IV. *Old Hæmatocele.*

Indications. Failure of previous treatment, especially in a man of middle life whose activity, *e.g.* in riding, is much interfered with.

The frequency with which malignant disease follows on repeated injury and irritation of the testicle is well known. [3]

[1] *Diseases of the Testis*, p. 342.
[2] Baumgarten, German Surg. Congress, 1901.
[3] Rindfleisch, *Path. Hist.*, vol. ii, p. 197.

V. *Retained Testis.*

Indications. (1) When such a testis is the seat of malignant disease. (2) When it seriously cripples the patient by the recurrent attacks of inflammation associated with it. (3) When the testis gets twisted or strangulated and necrotic, as the result of a long meso-testis which commonly exists in these cases. (4) When a co-existing hernia cannot be kept up by a truss owing to the presence of the testis, a radical cure of the hernia should be undertaken, and if the patient be well over puberty, the testis should be removed, for it is very unlikely to be functional, and therefore it is not worth attempting to place and keep it in the scrotum. In a child under these circumstances it is sometimes important to save the organ and perform orchidopexy, as well as a radical cure of the hernia.

Operation. The surgeon protrudes the testicle with his left hand so as to make the overlying tissues tense, and divides these from an inch above the external abdominal ring, prolonging his incision as required.[1] In cases where the skin is involved by a growth, ulcerated by a hernia testis, or invaded by tubercle, two elliptical incisions should be made, well wide of the disease, and meeting above and below. The first incision having exposed the cord above, this is hooked up, while the scrotal tunics are quickly shelled off by gauze dissection.[2] The spermatic cord is now isolated as high as may be needful, the inguinal canal being opened, if this is necessary to get above the disease. An aneurysm-needle, threaded with a double ligature of strong catgut, is passed through the cord, the loop of the ligature cut, the needle withdrawn, and, the cord having been tied in two halves, the ends of one ligature are cut short, while those of the other are tied round the whole cord to ensure that no vessel escapes. The cord is then clamped and divided below, but not too near to the ligatures, which may otherwise slip. If no bleeding occurs the ends of the ligature can be cut short, and the cord thus allowed to recede out of sight. The cord should not be divided before the ligature, for the latter is useful to keep the stump of the cord from receding before it is certain that the vessels have been efficiently controlled. The ligatures being thus embedded in the cord substance, there is no risk of their slipping. When there are sinuses or abscesses in the scrotum, the cord is isolated, ligatured and divided before the incision is carried down into the infective tissues of the scrotum.

The wound is then examined in the case of a soft, rapid growth, and where a tubercular testis has threatened to fungate, any suspicious skin must be clipped away.

A few scrotal vessels, notably one in the septum, may require securing. The wound is then closed with salmon gut, pains being taken to meet the tendency of the scrotal edges to invert. A tube is left in the lower part of the wound for thirty-six hours.

Every precaution should be taken during and after the operation to promote rapid healing, especially in hospital practice. Patients who have to submit to castration are often reduced in health, and septic sinuses are often present, so that suppuration is apt to occur unless great

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[1] Kocher makes a transverse incision across the lower pole of the testis in septic cases and large tumours. The incision is parallel to most of the large scrotal vessels, and little bleeding occurs, and, above all, the drainage is excellent.

[2] There is often an adhesion below between the testis and the fundus of the scrotum (Fig. 319). This represents, according to some, the remains of the mesorchium.

care is taken to sterilise the parts as far as possible, and to provide efficient drainage ; moreover, septic thrombosis may easily follow a wound here. Just before the operation the sinuses should be cauterised, so that they may not infect the wound.

In clean cases, and those with only moderate enlargement, I think very highly of Kocher's incision, which is made over the lower part of
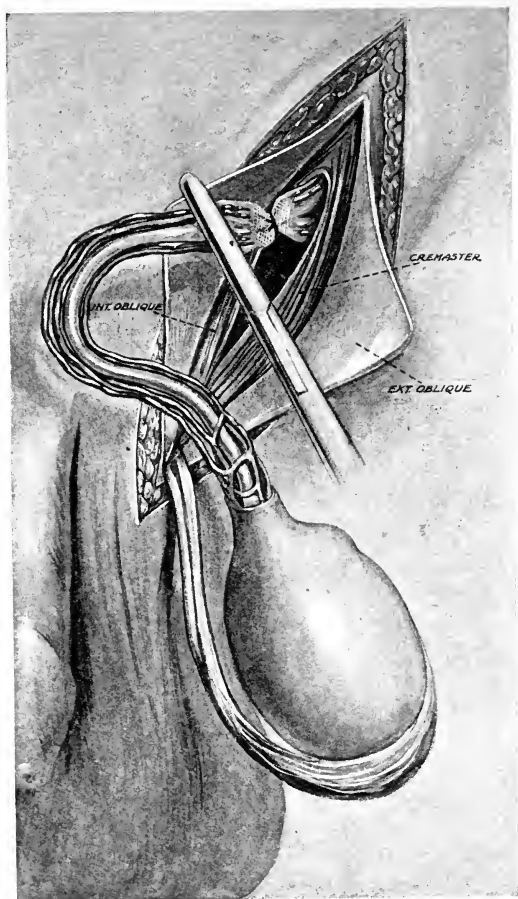
Fig. 319. Castration. The inguinal canal is opened and the cord separated up to the internal ring or even higher. It is crushed and tied with catgut.

the inguinal canal and the external abdominal ring just below which the intercolumnar and the cremasteric fasciæ are divided and the cord exposed high up and ligatured and divided as described above. The canal must be opened in tuberculous cases and most of the abdominal part of vas is to be removed. The testicle is then shelled out, all hæmorrhage stopped, the wound completely sewn up, and the dressings applied firmly to prevent any oozing. The advantages of Kocher's incision have been enumerated at p. 751.

RADICAL OPERATION FOR MALIGNANT DISEASE OF THE TESTICLE

As already pointed out on p. 755 the limited operation of castration described above, when adopted for malignant disease, has not been attended by great success. The majority of growths of the testicle are malignant or potentially malignant, and sooner or later infect the lymphatics and the lumbar glands. It is true that Nicholson did not find sarcoma invading the lumbar glands, but this growth is far less common than used to be supposed, for the encephaloid form of carcinoma has been very frequently mistaken for it. For the great majority of growths of the testicle, it is wise to remove the draining lymphatics and lymphatic glands at the primary operation. Morris [1] as long ago as 1895 removed with great difficulty a mass of secondary glands in the loin two years after castration for carcinoma, and the patient survived for nine years, but ultimately died of secondary growth invading the spine and causing intestinal obstruction. Roberts [2] performed a similar operation, but the patient died. As a rule when the lumbar glands are considerably enlarged an attempt to remove them is inadvisable, for the disease will have spread to the secondary glands higher up, which are irremovable. Our endeavour should be to operate early and to remove the lymphatics and glands in one piece with the testicle. Sir John Bland-Sutton [3] describes such an operation in detail with an interesting case. The patient, although he developed a secondary growth in the neck six months later, was well two years afterwards.

The following remarks are taken from a valuable paper by Mr. Morriston Davies.[4]

" **Treatment.** Very slowly has it dawned upon surgeons that malignant growths of the testicle should be treated in the same rational manner as malignant disease of the tongue or breast—so slowly, in fact, that since Grégoire did the first complete radical operation in 1905 only 12 cases treated in this manner have been recorded. At the present time every surgeon recognises the imperative necessity of removing the glands and lymphatics (with the surrounding fascia) which drain an area, such as the tongue or breast, the seat of a malignant growth ; and the enucleation of the infected glands in such cases is regarded in almost the same light as attempting no gland operation whatever ' because there is no clinical evidence of involvement.' There is no reason why the same radical treatment should not be adopted in cases of malignant disease of the testicle ; that the glands are at a distance from the primary growth and need a much greater amount of care and trouble to remove is no contraindication whatsoever. It is quite feasible (and the danger of the operation is incomparably small compared with that of recurrence when the testicle only is removed) to take away the testicle, cord, the artery and veins of the vas up to their origin from the aorta and entry into the vena cava or renal vein, the lymphatics draining the testicle, the glands into which they drain, and the surrounding fascia in one piece. The heavy mortality from recurrence in cases of simple castration, the proportionate frequency with which glands that could not be felt clinically and apparently normal macroscopically have been found on microscopic examination

[1] *Lancet*, 1912, vol. i, p. 634.   [2] *Ann. of Surg.*, 1902.
[3] *Lancet*, 1909, vol. ii, p. 1406.   [4] *Lancet*, 1912, vol. i, p. 419.

to be invaded by growth, should be sufficient to make the radical operation the routine procedure.

" Before giving details of the operation a fuller understanding of the lymphatics of the testicle is necessary. Numerous experiments have been made by the injection of coloured fluids and dissections by Jamieson and Dobson, Most, and Cunéo. These researches have shown that the glands which are in direct communication with the testicle lie on either side, over, and between the inferior vena cava and the aorta usually between the level of the bifurcation of the aorta below and the renal veins above, but that occasionally a gland may be found as low as the bifurcation of the common iliac, and as high as just above the renal veins. From this group of glands lymphatics pass out laterally, upwards and downwards to other glands, the uppermost of which are in close relation to the receptaculum chyli. From clinical evidence (and the ease with which injected substances pass through the primary into the secondary group of glands) it seems that the secondary outlying groups may be infected soon after the primary ones have become diseased. Certain it is that when once the glands have become palpable dissemination of the disease progresses rapidly.

" The secondary glands lie so high up in the abdomen and are so covered by the duodenum, pancreas, &c., that they are very difficult of access. So long as the diagnosis of growth of the testicle is made fairly early and the radical operation is undertaken before the primary group of glands is extensively implicated, it is sufficient if these only are removed. The lymphatics of the primary group connected with the right testicle lie to the outer side and over the vena cava, between it and the aorta, and over the right half of the aorta, while those connected with the left testicle have no relation to the vena cava but lie over and on the left side of the aorta. The glands have been removed by the intraperitoneal and the extraperitoneal routes ; the latter is undoubtedly preferable.

" **The Radical Operation.** The incision which has been most often employed to allow of removal of the testicle and cord and to give access to the lumbar glands commences over the upper part of the scrotum, extends up to the external ring, along the inguinal canal, and is prolonged to a point half an inch above the anterior superior spine ; the incision then curves upwards till it reaches the costal margin at the level of the tenth rib. At the beginning only the first part of the incision to the external ring is made and the testicle and cord are dissected free. If there is any doubt as to the diagnosis the testicle should be incised at this stage. If malignant disease is present the operation is continued. The incision is prolonged in the direction defined above and carried through the muscles of the abdominal wall until the peritoneum is reached. The cord is traced till it passes through the internal abdominal ring, and then while the sides of the incision are strongly retracted slight tension is applied to the cord so that its further course may be easily recognised. In its retroperitoneal course the vas is adherent to the posterior aspect of the peritoneum and the next stage in the operation consists in freeing the cord and reflecting the peritoneum mesially. The cord is traced down well into the true pelvis and there divided between two ligatures, the cut surfaces being treated with the cautery or pure carbolic. This may be regarded as the first stage in the operation and requires no extraordinary care. The second stage consists in the free dissection of the fascia over part of the iliacus and psoas muscles together with the contained spermatic

vessels and lymphatics and the removal of the glands from off the inferior vena cava and aorta (*see* Fig. 320).

" When the vas has been divided the spermatic vessels are seen no longer to form a rounded bundle but to become spread out. It is therefore necessary to make a wide dissection of the fascia. On the outer side this should extend to the outer border of the psoas. On the inner side the line
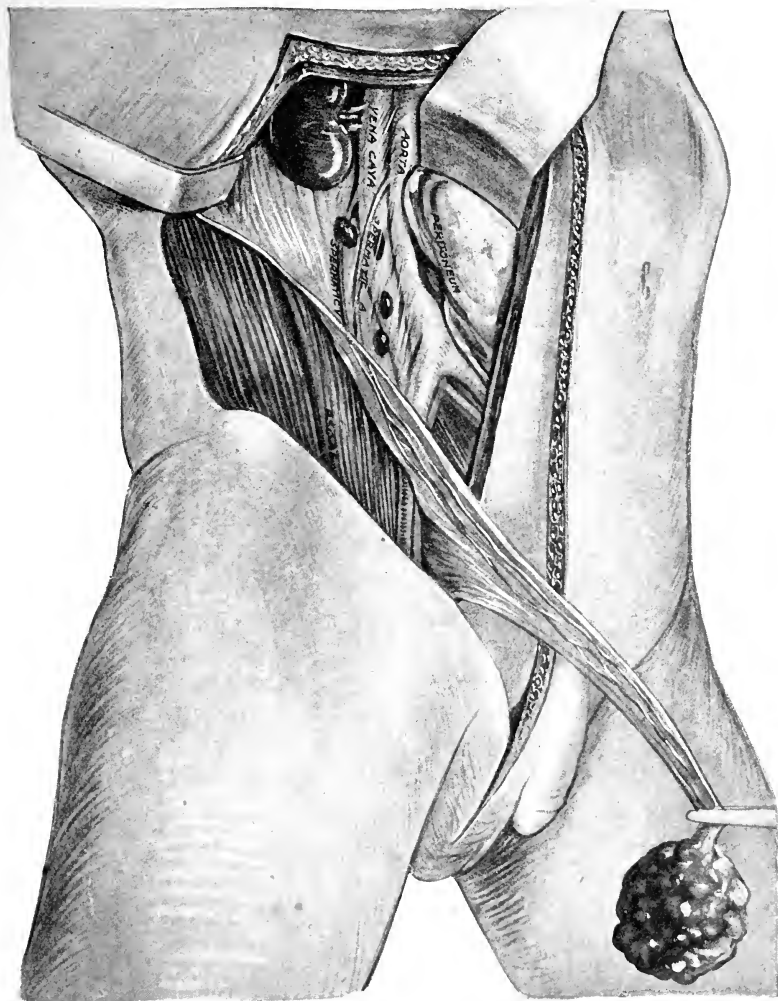
FIG. 320. Radical operation for malignant disease of the testicle. The draining lymphatic vessels and lymph glands are removed with the primary growth in the testis. (Modified from Chevassu.)

of division of the fascia should pass mesially so as to cross the common iliac at its bifurcation ; the ureter will here be encountered and must be freely exposed. The dissection is then carried along the inner side of the common iliac vessels up to the bifurcation of the aorta. When the left testicle is affected the inner boundary is carried up along the right border of the aorta, and special care must be taken not to injure the inferior

mesenteric artery. When the right testicle is the seat of the tumour the inner border is continued over the middle of the aorta. In both cases the upper limit is the upper border of the renal veins. Between these bound-aries all fascia, lymphatics, and glands must be removed. During the dis-section the spermatic vessels are traced up to their junction with the main vessels and must be ligatured and divided. When all bleeding-points have been secured the peritoneum is allowed to return into position and the abdominal wound is closed without drainage, each of the muscles being stitched up separately."

I prefer to drain the large deep wound for thirty-six hours, and to adopt Bland-Sutton's vertical incision through the linea semilunaris. This gives a more direct access to the lymphatic area and, moreover, it is easier to close the abdomen satisfactorily. So far only eighteen cases [1] of this radical operation have been recorded with three deaths from the operation. The ultimate results have not been ascertained in most of the cases. It is too soon to judge whether the results are so much better than those of simple castration as to justify the greater danger of the far more extensive operation. It is to be hoped that they will be ; on theoretical grounds we would expect the risk of recurrence to be reduced. Both the immediate and ultimate results of all these operations should be published. Mr. Morriston Davies' patient had a recurrence within a year of a very thorough operation.

EPIDIDYMECTOMY

Indications. (1) *Certain cases of tuberculosis of the testicle.* There are still differences of opinion as to the relative value of epididymectomy, orchidectomy and curetting for this disease. I am not in favour of curet-ting. The relative advantages of the other two operations should be considered in every case, for these depend on the extent of the disease and the condition of the patient. Barney [2] in an analysis of 153 cases, many of which were treated by epididymectomy, found no local recurrence in any case after this operation. Therefore, as regards local recurrence, epididymectomy seems to be as satisfactory as orchidectomy. As regards infection of other parts of the genito-urinary organs, especially the opposite epididymis, Barney found that this was just as likely to follow orchidec-tomy as epididymectomy. This is not very surprising seeing that on admission 50 per cent. of the cases had similar disease of the prostate or vesiculæ, and 30 per cent. had disease of both epididymes. It is clear that epididymectomy is indicated under the following circumstances :

(*a*) All cases of tuberculous disease of a solitary or remaining testicle unless the body of the testes is seriously affected, for it is important to preserve the latter or even a well-nourished portion of it for its internal secretion in order to prevent melancholia and preserve the male charac-teristics.

(*b*) When the disease is bilateral orchidectomy may be done on the worse side, and epididymectomy on the other.

(*c*) For early unilateral disease localised to the epididymis, epididy-mectomy may be performed, but the body of the testes should be incised to see if there is any evidence of disease invading its posterior part. The objections to this plan are :

(i) That it is not always possible to decide that the body of the testes

[1] Seton Pringle (*Lancet*, 1912, vol. ii, p. 1654) records a case and the patient was well at that time, six months after the operation.
[2] *Boston Med. and Surg. Journ.*, 1911, vol. ii, p. 913, and *ibid.*, 1912, vol. i, p. 409.

is healthy without microscopical examination, but this objection does not hold if the pathologist is ready to cut and examine a section during the operation. However, all the local disease may not be removed in some cases, but may be even stirred up and induce a general miliary tuberculosis, which accounted for the mortality of over 5 per cent. in Barney's cases. The incision into the testicle may actually infect the latter.

(ii) The operation is not likely to be so clean as orchidectomy when the testicle is removed " en masse " within its coverings, so that post-operative sinuses are more likely after epididymectomy.

(2) *Certain cases of extensive cystic disease of the epididymis in elderly men.* These cysts sometimes cause much pain and swelling or induce vaginal hydrocele.

Operation. When there is no adhesion to the skin or sinus, a Kocher incision is made over the external ring, and the testicle is displaced upwards and out of this wound, but an elliptical incision is made around any adhesion or sinus, which are generally located at the posterio-lateral and inferior part of the scrotum. The tunica vaginalis is freely opened and examined. Occasionally it is tuberculous ; then orchidectomy must be performed. The testicle and epididymis are examined. If the former seems healthy the reflections of the serous membrane extending from it to the epididymis are incised, and the globus minor is separated from below upwards. As the globus major is approached care must be taken to preserve the blood-supply of the testis, which enters the latter near the upper part of the globus major and on the inner aspect of the latter. The attachments of the globus major are divided and any bleeding vessels are tied. Then an incision is carried forwards through the meso-testes into the body for about half an inch, and if the testis is healthy the wound is closed with catgut and all bleeding-points are stopped by suture. Then the vas deferens is followed up and removed together with the loose connective tissues around it. Generally it is sufficient to remove as much as can be drawn down through the external ring, but if there is any evidence of disease higher up the inguinal canal must be freely opened, and as much of the abdominal part of the vas removed as possible.

ORCHIDOPEXY

Indications for Operation. (1) The co-existence of a hernia, which cannot be retained properly on account of the malplacement of the testis. In very nearly all the cases a potential hernial sac exists, so that a hernia may develop at any time in those in which the serous canal is sufficiently wide or distensible. Such a hernia is peculiarly apt to become strangulated on its first descent.

(2) Attacks of pain, either from twisting of a long mesorchium, which is commonly present, or from nipping at the external ring, or pressure within the canal. Strangulation and gangrene of the testicle may occur from twisting.

(3) Age. It is rarely of use to attempt to bring the testis down after puberty (*vide infra*). It is better to remove it after this age, when only one testis is retained and causing trouble. At one time it was necessary to save the testicle to gain admission into the Army or Navy ; now it is only necessary to cure the associated hernia, and the testis may be removed if desirable.

(4) Retention in the canal or at the external ring, but not when the testis is within the abdomen.

One or two preliminary questions arise here : What is the value of the retained or ectopic testicle ? At what age ought the operation to be performed ? These may be answered together. It will be seen by reference to the account given at p. 45 *Diseases of Male Organs of Generation* of the condition of the retained or ectopic testicle, if nothing be done, that the following are certain : (*a*) that such a testicle ultimately becomes, and usually before adult life is reached, physiologically useless ; (*b*) that, as some of the cases I have given show, during the early years of life the testicle, though ill developed, may be capable, under more natural surroundings, of becoming a useful organ ; (*c*) that the period in which the testicle passes from a probably useful into a useless state must be an uncertain one, varying with the attacks of inflammation, &c. Most French surgeons have advised deferring the operation until the age of about sixteen, as up till this time a retained testicle may still descend. While this is true, I should strongly advocate resort to operation at an earlier date, a step which I have taken in the cases given below, on the following grounds : It must always be quite uncertain at what date structural changes marring the efficiency of a testicle have set in. These must depend on the number of recurrent inflammatory attacks, and children are certainly not exempt from these. Again, in cases complicated with a hernia, the longer an operation is deferred the more difficult will it be to ensure a radical cure. Moreover, a condition of this kind, interfering as it may with activity and enjoyment of life, schooling, apprenticeship, &c., should be put right as soon as possible. Finally, if the testicle's growth and development are to be furthered by the transplantation—and this is one great object of the operation—it is surely more probable that this end will be secured by bringing the testicle into its natural home before puberty, that important epoch, and its consequent sexual changes have set in. I should prefer operating between the ages of eight and nine, though in the case of the children of the poor, where time is of great importance, I should consider it quite justifiable to operate earlier, especially if there has been any attack of pain, or if a troublesome hernia co-exists. Before the age of two and three years the small size of the parts, their fragility as far as holding sutures go, and the difficulty of maintaining asepsis, are contra-indications to operative interference.

Operation. The tendency of the testicle to retract and even to re-enter the inguinal canal is so great, that I have adopted the following method in many cases with gratifying results.[1] An inguinal incision is made and the canal is opened in all cases. The cremasteric and infundibuliform fasciæ are incised freely and separated from the cord. The funicular process of peritoneum is followed up beyond the internal ring, transfixed, ligatured, and divided as described at p. 48.

The cord and testis are then freed, and traction is made upon them, while any retaining bands of cremasteric and infundibuliform fasciæ are divided, scissors beginning antero-externally. If necessary, some of the veins are then divided between two pressure forceps and tied with catgut, more being divided until the testis can be easily placed in its natural position without any tension. The vas is rarely too short to allow this, so that it is not necessary to adopt Wood's method of sepa-

[1] No claim of originality is made for this operation, which is a composite one, based on the work of others. Dr. Bevan (*Journ. Amer. Med. Assoc.*, September 19, 1903) describes a similar method, but he does not remove the parietal tunica vaginalis, nor does he take the same measures to prevent the reascent of the testis. Dowden (*Brit. Med. Journ.*, April 29, 1905) has removed the parietal tunica vaginalis and scraped the visceral layer.

rating the globus major from the testis and fixing the latter upside down in the scrotum. If the vas is not long enough, a little traction and gentle blunt dissection around it above the internal ring will liberate some of the pelvic part of the duct.

Care must be taken not to divide or injure the delicate connective tissues, vessels, and sympathetic nerves which surround the vas itself, less atrophy of the testicle ensue. In two of my cases little else than the vas and the structures mentioned were left undivided, and yet the testis came to no harm beyond some transient orchitis. The internal oblique and conjoined tendons are then sewn down to the deep surface of Poupart's ligament. The cord, or what remains of it, is not dislocated, so that it may not be shortened. The wound in the external oblique is closed, care being taken to make quite a small external ring.

The fibrous tissues of the cord may be sutured to the margins of the ring in some cases. The parietal part of the tunica vaginalis is excised, so that the testicle may adhere to the scrotal tissues, instead of slipping up within a serous sac. A new bed is made for the testicle by means of a gloved finger passed down into the scrotum. A stout catgut suture threaded on a long straight needle is passed from side to side through the part of the testicle which can be brought lowest, but well away from the epididymis and the vas deferens. The two ends of the thread are then brought out through the lower end of the new scrotal sac, by means of the long straight needle which is guided by the finger. Traction is made upon both ends so as to bring the testis down to its normal position. The suture is tied loosely over a small piece of cyanide gauze placed outside the scrotum.

At the end of the operation the long ends are fastened to a circlet, placed low down upon the opposite thigh, which is kept fixed to the bed.

The suture is only tied sufficiently tightly to keep the testicle and scrotum well down during the healing of the wound, and for about a week or ten days afterwards ; cyanide powder is dusted over the scrotal punctures.

The after-treatment is very important, for, as the new connective tissues in the depth of the healed wound along the cord tend inevitably to contract, the testicle is drawn upward towards the groin. This slow but powerful force must be counteracted by daily traction for at least three or four months, one or both parents being carefully instructed how to do this and also impressed with the importance of it.

Mr. Corner [1] prefers replacement of the retained testis within the abdomen to orchidopexy, because he believes that the retained testis rarely becomes functional, and that the internal secretion of the organ is retained just as well after abdominal replacement. I do not agree with these views, but prefer to perform orchidopexy for suitable cases, for this is more likely to be followed by development of the testis, if undertaken well before the age of puberty. Experiments upon animals tend to show that the normal testis atrophies if replaced within the abdomen before the age of maturity. Moreover, a testicle inside the abdomen has given rise to peritonitis. As a result of ascending infection in gonorrhœa hæmatoma of the testes has followed injuries of the lower abdomen, and growth of testis has occurred. Moreover, the testicle has descended into the canal together with a hernia in some cases. I should replace the testicle in the abdomen only when it is the only testicle and then causes pain, is associated with hernia, and cannot be brought down out of the canal.

[1] *Brit. Med. Journ.*, June 4, 1904.

OPERATIONS ON THE ANUS AND RECTUM

FISTULA. HÆMORRHOIDS. FISSURE. PROLAPSUS. IMPER- FORATE ANUS. ATRESIA ANI. IMPERFECTLY DEVELOPED RECTUM

Preparation. To lessen the unusual risk of septic infection which is associated with operations on the anus and rectum, and to diminish the post-operative discomfort, it is of great importance to prepare the patient adequately before the operation, especially before excision of the rectum for growth. The patient should be at rest, but not necessarily in bed, for several days (up to a week before excision of the rectum) before the operation, and on light, easily digested food which leaves but little residue. Milk in moderation, eggs, butter, cream, sugar, jelly, soup, olive oil, Benger's food, are valuable. The bowels should be kept well open for several days. It is better to start with one large dose of castor oil and to follow this by several smaller ones and, if necessary, by a daily enema. Although purgation is the only satisfactory way of bringing the colon and rectum into a state of operative cleanliness, especially when there is obstruction, it should not be overdone so as to weaken the patient, and no laxative should be given for twenty-four hours before the operation, but on the contrary peristalsis is to be inhibited by the administration of opium. The rectum and colon are thoroughly emptied by means of an enema given about three hours before the time fixed for the operation. If these precautions are taken, the bowels rarely act during or soon after the operation, and the fæces are far less infective, and consequently the wound is less likely to become infected. Salol may be given by the mouth, and weak antiseptic solutions may be used to irrigate the rectum in some cases.

FISTULA

Varieties. As these have a very practical bearing upon the operation, they must be alluded to here.

(i) *Complete.* (ii) *Blind External.* Here an external opening only exists, though in a considerable number of cases the internal opening is overlooked. (iii) *Blind Internal.* An opening through the mucous membrane is here the only one. This is the rarest, but an important variety, as, if overlooked, it is certain to be troublesome.

A discoloured spot or patch of skin sometimes marks the place where an external opening may occur. Mr. Lund[1] relates a case in which a very chronic and slowly advancing blind internal fistula had excited,

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[1] *Hunt. Lect.,* p. 88.

by its extreme end, just enough inflammatory thickening of the skin to imitate a keloid growth, for which it was at first mistaken.

Situation of Openings. Both of these are usually within an inch, more often half an inch, of the anus. The internal one may be detected as a slight depression or papilla by the finger, or by the speculum, or, in obscurer cases, by the sigmoidoscope.

Horseshoe Fistulæ. Here an external opening on either side communicates with a single internal one, often at the back. This is an uncommon, but an important variety, for if it be cut through the sphincter ani at both sides, some loss of control is very likely to ensue. This risk should be explained to the patient, and the shallower fistula should be scraped, while the deeper is freely incised. If it is necessary to cut the sphincter on both sides, the knife should be employed on two distinct occasions, time being given for the first to heal.[1] It is better to make a free opening on one side, and to scrape and pack the other limb of the fistula from the opening.

Multiple Fistulæ. This condition should always cause a suspicion of stricture, or extensive ulceration, *e.g.* syphilitic, tuberculous, or malignant.

Fistula with Tuberculosis. Where a fistula presents an external opening with undermined, livid edges, where the tubera ischii stand out prominently from emaciated nates, tuberculosis is always to be suspected, even if no history of cough or hæmoptysis is given.

Question of Operating on Phthisical Patients. While each case must be decided by itself, the following remarks may be useful :

Where the phthisis is advanced, the cough incessant, the fistula multiple or branched, an operation is out of the question. On the other hand, where the physical signs are little marked, night sweats slight or absent, where the fistula interferes with the patient taking the all-essential exercise, where the power of repair is good, an operation is indicated.

In cases intermediate between the above, each one must be decided upon its own merits.

Before operating the surgeon should remember that repair is here often sluggish, the mental condition much depressed. He should do all he can to improve the general condition before and after the operation. And if this can be performed in sunny weather, or, better still, at the seaside, so that the patient can soon have fresh air in the recumbent position, so much the better.

Operation. The patient being under an anæsthetic, and either on his side with the knees well flexed, or better in lithotomy position, the surgeon introduces lightly a probe-pointed pliable director. In the case of a complete fistula, the internal opening being hit off, the point of the instrument is felt for by the finger and hooked out of the anus. If, after careful examination, the surgeon is satisfied that no internal opening exists, he makes one by finding the exact spot at which the coats of the bowel are most thinned, and thrusting the point of the probe through here.

In the case of a blind internal fistula the internal opening must be found with a speculum, and a probe, curved, passed from this so as to

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[1] Mr. Cripps (*Dis. of Rectum and Anus*, p. 165) shows that if, in women, the sphincter is cut through anteriorly where it decussates with the sphincter vaginæ, incontinence of fæces is very likely to take place.

project beneath the skin. In every case the whole length of the sinus between skin and bowel must be completely laid open by dividing the bridge raised by the grooved director or probe. When this has been done, very careful examination is made for other sinuses by the introduction of the probe, and by pressure with the finger, which squeezes out any discharge, and feels for indurated tracks. Wherever these run they must, if possible, be laid open. I have already alluded to the question of dividing the sphincter in two places. It is also important not to carry the incision higher into the bowel than is absolutely necessary; but free drainage must be provided by prolonging the incision far enough outwards into the ischio-rectal fossa. Every attempt, however, should be made, with the aid of a good light and forcible dilatation of the sphincter, to lay open every sinus with bistoury or scissors, extra care being taken, the higher the incision has to be carried, to arrest all bleeding.

While the sinuses are being followed up, any old gristly tissue must be
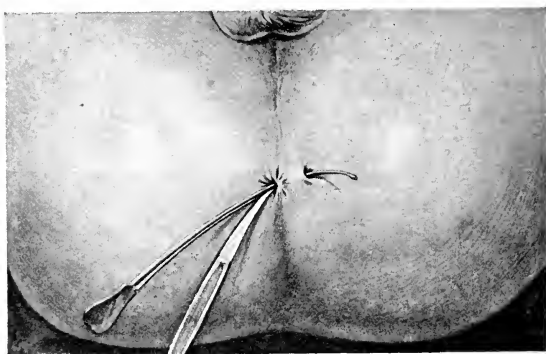
FIG. 321. Operation for fistula in ano.

completely removed, all pyogenic or granulation tissue entirely scraped out, and every ill-nourished flap and tag of undermined skin cut away.

If any troublesome piles co-exist they should be removed at the same time.

As a dressing I prefer a narrow strip of cyanide gauze. Less and less should be reapplied daily as granulations become established. After the first week little more is needed than daily cleansing of the wound with a dossil of cotton wool on a Playfair's probe. If the edges of the wound close too soon they should be separated with a probe from time to time, or any redundancy may be painted with cocaine and snipped away.

Finally, no operation better exemplifies the truth of Mr. Curling's saying that the surgeon should be his own dresser.

Immediate Union of Fistulæ. Mr. Reeves recommended this treatment some years ago.[1] It certainly has the advantage of often shortening the treatment greatly, and preventing loss of sphincter power, but at the risk of two dangers: (1) Sepsis. (2) The part within the bowel is sometimes difficult to suture satisfactorily, and may persist as a sinus

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[1] *Brit. Med. Journ.*, 1887, vol. i, p. 917.

later. The method may be tried in simple cases which do not extend far into the bowel.

Operation. The anus having been well dilated, the fistula is laid open, thoroughly scraped out. Any skin or mucous membrane which is unhealthy or which will get between the edges of the wound must be snipped away, the bleeding stopped, the wound well irrigated with lot. hydr. perch. (1 in 4000) and well dried out. It is then united in its whole extent by sutures of salmon-gut or sterilised silk. The sutures must underrun the wound, so that the depth of the latter may be efficiently closed. These are left in for a week or ten days.

HÆMORRHOIDS

Indications. (1) Continuance of hæmorrhage or discharge, and persistent liability to descent of piles in spite of judicious treatment. Prolapse of the hæmorrhoids may interfere with sitting, walking, and riding.

(2) Repeated attacks of strangulation and thrombosis of the pro-lapsed piles.

(3) Severe pain from associated fissure of the anus, or prolapse of the rectal mucosa.

(4) Absence of enlargement of the liver due to cirrhosis or other disease.

In Mr. Cripps's words [1] "the smallness of the risk should not lull the surgeon into a sense of absolute security, and he should spare no effort in ascertaining the general constitutional condition of his patients. . . . The amount of risk, slight as it is, should be clearly laid before the patient or his friends. If a man is to have some grave operation per-formed, such as the removal of a cancer or the amputation of a limb, both he and his friends are well aware of the risk involved, and are accordingly prepared. It is, therefore, in the smaller operations, regarded by the surgeon and public as free from danger, that a fatality, when it does occur, becomes so tragic from being unexpected."

OPERATIONS. Ligature and Excision—Cautery—Excision and Suture—Whitehead's Operation.

(i) **Ligature.** I have placed this first because, if properly used, it is a very easy, rapid, and good method. Here, as elsewhere, that surgeon will have the best results who has thoroughly familiarised himself with the detail of one operation. The following appears to me to be a fair way of putting the merits of ligature and the other operations :

(1) In my opinion the ligature is more generally suited to all cases. Again, it can be more easily applied to piles high up than can the cautery. (2) No special instruments are needed. (3) A ligature applied is done once for all; the cautery may have to be reapplied more than once if bleeding follows when the clamp is unscrewed. (4) The risk of bleeding is less, and hence this method is especially advantageous in anæmic patients, and in those for whom it might be difficult immediately to obtain surgical aid (Allingham). (5) The ligature is free from the objections to the cautery in private practice, viz. the smell, and, unless a Paquelin's cautery is at hand, the cumbersome apparatus otherwise rarely used.

[1] *Loc. supra cit.*, p. 99.

Operation. The preparatory treatment is that given at p. 766. The patient being in the lithotomy position on the left side, the anus should always be dilated. This may be done by introducing, and then separating laterally, the two thumbs, the pressure being steadily maintained so as not to rupture the mucous membrane. After a few minutes a sensation of yielding rather than of tearing is perceived.[1] When the sphincters are thoroughly dilated and the rectum is cleansed, the piles which lie lowest according to the patient's position[2] are drawn down with a vulsellum or tenaculum-forceps, and the surgeon with blunt-pointed scissors, curved on the flat, cuts a groove around the lower two-thirds of the pile, which is then separated for this distance from the submucous and muscular coats by blunt dissection. In the lower piles this groove should commence in the sulcus, which marks the junction of skin and mucous membrane close to the anus. The object of this deep groove is twofold: it forms a bed in which the ligature can be sunk tightly, and, above all, it leaves a very small pedicle of tissues to be strangled. The groove, moreover, can be cut without risk of hæmorrhage, as, however large the pile, its vessels enter it from above, running into its upper part just beneath the mucous membrane. The surgeon then ties round each pile, which is now still further dragged down, a ligature of sterilised silk, the strength of which he has previously tested. Sinking this into the groove, he tightens it up so as to embed his ligatures firmly, without cutting through the pedicle. About two-thirds of the pile are then cut away, enough being always left to ensure a safe hold for the ligature. In Allingham's *Diseases of the Rectum* (p. 146), the following most important practical point is insisted on. When the piles are separated from the bowel preparatory to applying the ligature, it is essential that the base to be ligatured should be as narrow as is consistent with safe securing of its blood-supply. For if many piles have to be tied, and their bases are left large and broad, when tied up they draw the mucous membrane together, and cause great narrowing of the rectum. In such a case it is almost impossible to introduce the finger, without force, beyond the parts tied. In other words, islets of untied mucous membrane, as wide as possible, should always be left between the tied piles. This will secure less pain, easier action of the bowels, and less risk of contraction. After every internal pile has been carefully treated in this way, the external ones are partly clipped away, care being taken not to encroach upon the junction of skin and mucous membrane, and not to remove subcutaneous tissue for fear of subsequent contraction. If any bleeding-points still persist, they should now be tied. The ligatures are all cut short, and, lastly, the stumps of the piles are returned. A morphia suppository is then introduced and a dressing of sterilised gauze and wool applied, and firm pressure made with a **T**-bandage. To hasten healing and prevent contraction, I generally close the longitudinal wound left after the excision of each pile by suturing it in a transverse direction with a continuous catgut suture. The ligature upon the stump of the hæmmorrhoid is thus brought down to the anal margin.

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[1] Eversion of the rectal mucous membrane by the finger in the vagina will often be most helpful in bringing piles within reach.

[2] This prevents the other hæmorrhoids being obscured with blood. Mr. Allingham advises that the smallest piles should be taken first, as there is a danger of these being overlooked and thus leading to a recurrence of the disorder.

When many hæmorrhoids have to be removed this simple plan prevents any narrowing of the orifice.

(ii) **Clamp and Cautery.** The preparatory treatment and position of the patient are those already given. The piles having been sufficiently protruded, and the anus forcibly dilated, they are drawn well down, one by one, with vulsellum forceps, and enclosed within the blades of the clamp, which is screwed tightly up. With scissors curved on the flat the pile is then so cut away as to leave a sufficient stump. This is then thoroughly seared down with a Paquelin's cautery, carefully kept at a dull red heat. If the iron sticks at any moment, owing to its cooling down, it should not be pulled away, but loosened by heating it a little. The clamp-screw is then slightly relaxed, and if any bleeding takes place it is at once tightened up, and the cautery reapplied. Every care must be taken to burn down the stump thoroughly at the first attempt, for if this fail, and oozing take place, it is not easy to stop the bleeding, from the tendency of the stump to slip through the slackened clamp. The piles having been successively dealt with in this way, the stumps are smeared with iodoform ointment and pushed well up with a finger coated with the same.

This method is thought by some to secure more rapid healing with less pain than the ligature. This, however true of the old methods, does not hold good when the piles are freely detached and the ligatures tied with the precautions already given. The clamp is less easily manipulated in the rectum. It is a special instrument not always at hand, and the smell entailed by the cautery is most unpleasant. The surgeon who uses it must be extremely careful to keep his seared surfaces as small as possible, and by no means to entrench upon the skin. It is well known how slowly, how painfully, and with what a tendency to contraction burns heal. The cautery is a troublesome instrument to carry about, and not infrequently gets out of working order just when it is most wanted, and for no very obvious reason. I greatly prefer to use the more exact, simple, and comparatively painless excision and suture method. The cautery ensures asepsis at the time of the operation, and hence it was a comparatively safe method before the days of aseptic operations, but the slough must separate by ulceration, which makes the convalescence of the patient more painful and uncertain with this than any other method used at the present day.

(iii) **The Operations of Robert Jones and Thelwall Thomas.** Very similar operations were independently devised and described by these two surgeons. Mr. Robert Jones published the following account in 1893 : [1]

" The hæmorrhoid is placed within the clamp (Smith's by preference) and cut off, leaving about an eighth of an inch of pedicle. This cut edge is sewed with a catgut suture, the clamp removed, and the operation is complete. The best plan is to take a piece of catgut about eighteen inches long, with a needle at each end. One needle is passed through the upper end of the pedicle, and a first knot is tied ; then the needles are passed from left to right and right to left, and each time they cross the pedicle they are tied. Except in the case of· friable granular hæmorrhoids, I shall not use the cautery again ; and I am inclined to believe that stitching the pedicle is more in accord with

[1] *Prov. Med. Journ.*, 1893, p. 400.

one's surgical instinct than burning it, which of necessity means the subsequent separation of a slough."

Mr. Jones now uses narrow-bladed special clamp forceps, one of the blades of which is spiked to prevent the instrument slipping.

Mr. Thelwall Thomas [1] gave the following description of the operation, which he had then performed for several years :

Operation. The sphincter having been stretched, "a large pile is seized by artery forceps, and its base clamped, the clamp being always put on in the long axis of the bowel. I have most frequently used Smith's clamp, but a dressing forceps with a catch will do quite as well.[2] The bulk of the pile is cut away, leaving a small stump standing off the clamp. The treatment of this is the essential feature of the operation. A piece of catgut, not too fine, about a foot in length, with a domestic needle at each end, is used for a suture. Commencing at
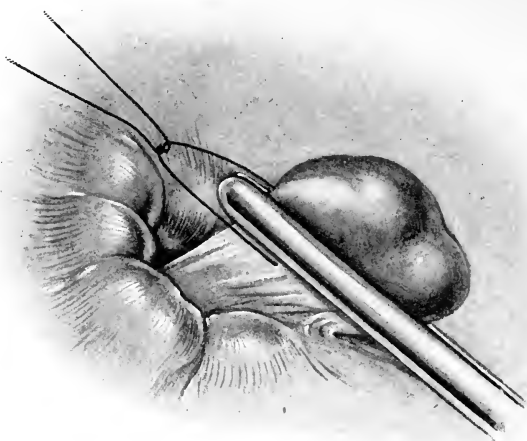
FIG. 322. Excision and suture operation for piles. The first turn of the suture secures the main artery of the pile.

the top end of the stump, one needle is passed through, and the catgut follows until there is one half the length of the suture on each side, with its own needle attached. A reef knot is tied on the stump, and the needle which is on the right side is brought over to the left and passed through the stump lower down and back again to the right. The needle which is on the left is taken over to the right and passed through the stump back to the left immediately adjoining the previous one. A reef knot is again made, and so on to the end of the stump, making five or six crossings to the inch. This method of suture brings the cut edges of the mucous membrane tightly together, and its advantage over a simple continuous suture is apparent, each cross and knot making each segment independent of the next. The clamp is slackened, and occasionally, though rarely, it may be necessary to tie a small vessel at the top end of the stump, particularly if a cross-acting clamp is used. All the internal piles are thus treated." The great advantages claimed

[1] *Brit. Med. Journ.*, November 26, 1898.
[2] Later Mr. Thomas says that he has found Doyen's broad ligament clamp (small size) superior to all others. These are apt to slip, however.

for the operation are (1) that primary union is obtained, and so convalescence is more rapid ; (2) that reactionary and secondary hæmorrhage is prevented.

Mr. A. B. Mitchell, of Belfast,[1] also uses a continuous catgut suture, but he only knots it twice, just beyond the extremities of the wound. The first turn secures the main artery before it enters the stump. The tail thread is left long, and the continuous suture is rapidly passed round the clamp, so that the thread gets a wider grip and is more hæmostatic. The clamp is withdrawn when the suture has been placed, and traction is made upon both ends of the thread, so that accurate apposition may be obtained without puckering of the wound. The lower knot is then tied, and the upper and lower tail ends are cut off.

Dr. L. S. Pilcher, of New York,[2] describes and figures an operation
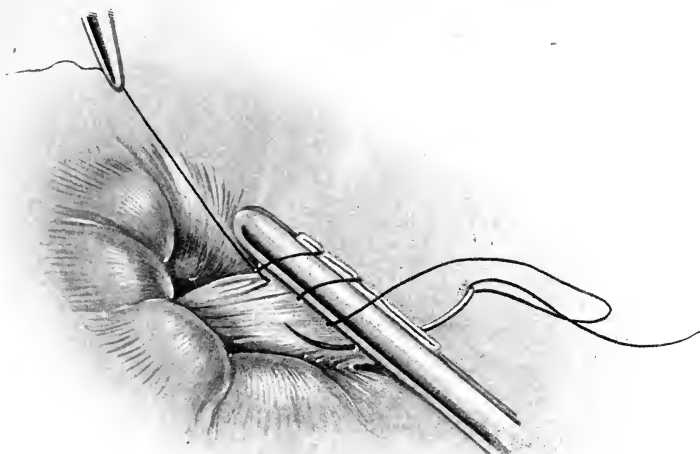
Fig. 323.   Excision and suture operation for piles.   The forceps are removed and the upper and lower ends of the catgut suture are tied together, thus puckering up the wound and preventing hæmorrhage.

almost identical with that of Mitchell, except that he does not apply the clamp forceps until he has severed the redundant perianal skin below each pile and has separated the lower part of the latter from the sphincter. He removes more of the skin than most surgeons do. This prevents the formation of œdematous tags of skin at the anus.

The excision and suture method with the aid of clamps is the most suitable one for most cases of piles ; but it is not applicable to the very worst, for which Whitehead's operation is to be preferred. The operation is a very safe and comparatively easy one, and most surgeons, especially those without much experience, will get far better results from it than from the more severe operation of Mr. Whitehead. When it is used for cases of moderate degree of severity (the majority) the results are excellent, and recurrence, although possible, is quite rare. On the other hand, if it is attempted for extensive disease encircling the lower part of the bowel, the removal is bound to be either incomplete

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[1] *Brit. Med. Journ.*, February 28, 1903.   [2] *Ann. of Surg.*, 1906, vol. xliv, p. 275.

or so extensive as to narrow the orifice when the sutures are tied. Recurrence is therefore likely to follow in such cases, although the removal of many strips of mucosa tends to brace up the remainder. It is, therefore, better to perform Whitehead's operation for bad cases in order to be certain of a permanent success.

(iv) **Whitehead's Operation of Excision of the whole " Pile-bearing " Area.**[1] This extensive operation is intended to bring about a radical cure, its object being not only to remove any existing piles, but also all the mucous membrane in the lowest part of the rectum, which is the seat of piles, owing to the tendency of its veins to become dilated. Though Mr. Whitehead has performed this operation in 300 cases
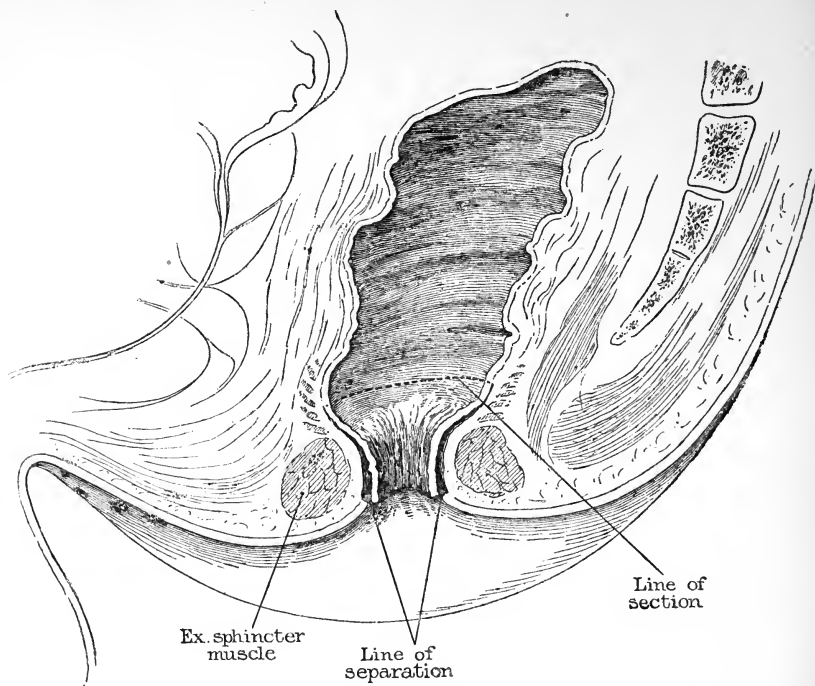
Fig. 324. Whitehead's operation. A tube of mucous membrane—the pile-bearing area—is isolated.

without a fatal result or any drawback, I consider it needlessly extensive and severe, especially in patients of middle life, and in a part which cannot always be kept clean. The operation by ligature, or by clamp and cautery, carefully performed, gives most excellent results, and, in answer to Mr. Whitehead's argument that as long as this diseased area is left to reproduce piles over and over again no permanent cure can be expected, I may say that I have always found that, after one of the above operations has been preperly carried out, the patient can easily prevent any recurrence by attention to common-sense details in daily life. Finally, I know of one case, in a young, healthy patient, fatal from acute septicæmia.

The following criticism [2] appears to me soundly based : " Mr. White-

[1] *Brit. Med. Journ.*, February 26, 1887.
[2] Allingham, *Diseases of the Rectum*, p. 139.

head terms his operation simple. Simple it may be, but difficult to perform, for with the anus rugose and elastic as it is, even after dilatation of the sphincters, it is not at all easy to separate the mucous membrane from the skin. The time required for the operation is an objection ; this process takes on an average at least thirty minutes, where a skilled surgeon can operate with the ligature in less than five minutes. The hæmorrhage by this method far exceeds the amount lost when the ligature is used, and this is of great importance in those patients who have already lost much blood from their piles. . . . Two or three days after the operation the parts not infrequently become swollen, and the mucous membrane then tears through the ligatures and retracts away from the skin. This leaves a large granulating surface which may
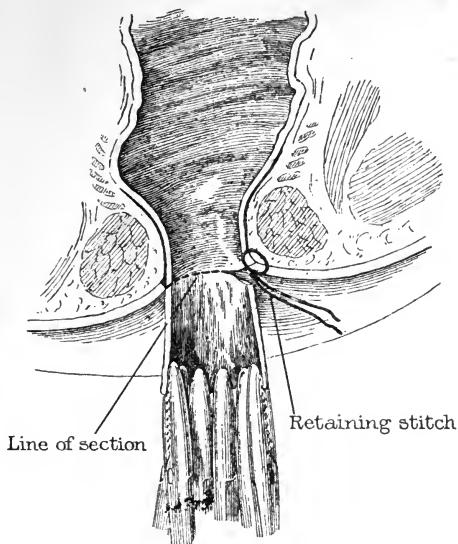
Fig. 325. Whitehead's operation. The pile-bearing tube is drawn down with pressure-forceps and gradually cut away. After each snick with the scissors a stitch is inserted. Either interrupted or continuous sutures can be used.

occupy the entire circumference of the bowel, and cause troublesome contraction."

Stricture of the rectum has occasionally followed Whitehead's operation; even when it has been performed by the ablest surgeons. Severe hæmorrhage has also occurred when the stitches have given way and the rectal mucous membrane has retracted. Both these catastrophes should be rare if the suturing be done with great care, but even the best work does not always prevent the stitches tearing out in malnourished and anæmic patients. It is fairly common for some temporary loss of anal sensation and control to follow Whitehead's operation. Careless operators or those without a knowledge of anatomy have even damaged the sphincter ani in separating the mucous membrane. I fear that a good many bad and imperfect results have not been published.

Despite these occasional accidents, the operation is a good one when skilfully performed for suitable cases ; but it is certainly not one to be undertaken lightly by surgeons of little experience. It is especially indicated for extensive and confluent hæmorrhoidal disease with laxity

of the anus and some prolapse of the mucosa and chronic inflammation. Such cases are not suitable for less severe and easier methods. Debilitated and very anæmic patients are not favourable subjects for it.

Operation. The patient is carefully prepared as described at the beginning of this chapter. The lithotomy position is adopted.

The sphincters having been thoroughly dilated, and the rectum well cleansed, a temporary plug of gauze is inserted above the field of operation to prevent any possible contamination with fæces. A ligature is attached to the gauze, so that the latter may be easily withdrawn at the end of the operation. The hæmorrhoidal area of mucous membrane is made to prolapse, and the prominent edge is seized with four long hæmostatic forceps, placed at equal distances from each other round the circle. Traction is made with the forceps, while the mucous membrane is divided with blunt-pointed scissors a little above the white line,[1] where the skin and mucosa meet. If the incision is made too low, the mucous membrane projects below the sphincter, causing moisture, itching, and bleeding at the anus. The mucous membrane is then dissected up with forceps and scissors, from the external and in part the internal sphincter, till the whole of the pile-producing area of mucous membrane can be pulled down and drawn outside the anus. It is then cut away, bit by bit,[2] transversely at its still attached upper border, each portion when divided being at once attached to the cut skin with sterilised silk sutures. In this way the diseased area is removed as a complete ring of mucous membrane.

It is of vital importance to use plenty of sutures both for controlling hæmorrhage, and also for securing firm and accurate apposition. Each suture must also take an ample bite of the rectal mucosa, so that it may not tear out prematurely, and for the same reason the threads must not be too fine.

Bleeding is at once controlled by finger pressure, until another suture is introduced to arrest it. It is not necessary to ligature any vessels. Before completing the operation the entire circular wound is examined, and a stitch is inserted here and there between the primary sutures wherever the apposition is not perfect or any bleeding occurs. This examination is facilitated by traction upon each primary suture in turn. The ends are then cut short, and the temporary plug is withdrawn. A morphia suppository (gr. $\frac{1}{4}$ or $\frac{1}{2}$) is introduced into the rectum, and sterilised dressings are applied. To keep the rectum at rest, no solid food is given for four days; hot drinks and milk are also avoided, for the same reason. On the fourth day an ounce of castor oil is given to secure a free and fluid evacuation. When the bowels have been opened, the diet is rapidly increased to full. A daily evacuation of the rectum is essential, otherwise hard scybala soon form and give rise to much trouble and pain. Cal. Coloc. et Hyos. gr. iv to viii at night, followed by a saline draught in the morning, answers well. The sutures are allowed to come away spontaneously. The patient is kept in bed for a week or nine days, and is allowed to walk out at the end of a fortnight. After the first day boracic fomentations are used and frequently changed, or the anus is sprayed with boracic lotion several times daily, and is thus kept quite clean. The stream of warm lotion is less painful than even the gentlest swabbing.

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[1] The " white line " of Mr. Hilton (*Rest and Pain*, p. 289, Figs. 51 and 52).
[2] So as to diminish the hæmorrhage, which would otherwise be free at this stage.

Causes of Failure and Trouble after Operations for Hæmorrhoids.
1. *Hæmorrhage.* This will be extremely rare if the precautions which have been mentioned under each operation are carefully observed, but it is most likely to follow Whitehead's operation, owing to the tearing out of stitches. It used to be not uncommon after the clamp and cautery. It is very rare indeed after the ligature and suture methods. The conditions under which this complication may occur are cases of long-standing piles or prolapsus in weakly subjects, cases where the tissues are very friable, where the patient insists on getting out of bed to pass water, or where he strains very much at the first action of the bowels. If the surgeon be called upon to meet it, the best means is to catch the vessels with Spencer-Wells forceps, and tie them with silk. Failing this, the centre of a large piece of antiseptic gauze is pushed well into the rectum, and the saccular part of it within the bowel is then filled with gauze strips until a pear-shaped plug is formed. Traction upon the sides of the sac of gauze brings the plug down against the sphincter or anal constriction, and effectually controls the hæmorrhage. The strips of gauze are easily removed. Styptics such as $\frac{1}{2000}$ of adrenalin chloride may be applied on the gauze. The plug should be left in as long as possible, the patient being kept under the influence of morphia if necessary.

(2) *Tedious Ulceration.* This is often due to the patients getting up too soon or the use of the clamp and cautery or the ligature method without any sutures for approximation of the mucous edges. The patients should remain in bed a week or ten days, and then be content to pass another week or ten days upon the sofa.

(3) *Septic Troubles.* These may follow from want of care in performing the operation, especially in cleansing the rectum very thoroughly.

(4) *Contraction.* This is usually stated to be only likely to occur when in cutting away piles, especially external ones, the junction of skin and mucous membrane is trenched upon. But the fact is that where many piles have had to be removed, where islands of mucous membrane (p. 770) have not been left between them, the ulcerated surfaces thus tending to coalesce, contraction of the surface as it cicatrises is very likely indeed to lead to some narrowing of the lumen of the gut. This must always be prevented by the early passage of the finger of the surgeon in charge, this being repeated daily if any tendency to contraction is found. Where a stricture, generally about one inch and a half from the anus, has been allowed to form, the patient's condition is a most vexatious one, though it will always yield to the use of bougies, aided, if need be, by nicking of the contraction.

A serious stricture is most likely to follow Whitehead's operation, from retraction of the rectal mucosa due to the stitches tearing out. This may be due to the use of too few or too fine threads, or to the insufficiency of the bite taken by each suture.

(5) Loss of anal sensation. (6) Loss of perfect control. These most often follow Whitehead's operation.

(7) Abscess. (8) Fistulæ. (9) Bubo. (10) Pelvic suppuration. These four are given by Mr. Allingham [1] as sequelæ in unhealthy patients, especially if the healing has been accompanied by prolonged suppuration The antiseptic surgery of the present day should almost prevent this.

[1] *Loc. supra cit.,* p. 163.

FISSURE [1]—ULCER

The operative treatment of these is so simple and so eminently successful, that it should be resorted to early.

A. **Operation by Incision.** The preparatory treatment and the position of the patient are the same as those already given. The division of the ulcer may be performed in one of two ways: (a) from without, (b) from within, the rectum.

(a) *From without.* Here the ulcer, being fully exposed with a speculum—and the one which bears Mr. Hilton's name, with a movable valve, will be found the best—a small sharp-pointed bistoury is inserted a little beneath the base of the ulcer, and its point made to protrude in the bowel above it; the parts are then divided from without inwards through the centre of the ulcer.

(b) *From within.* Here, the ulcer being also exposed either by stretching the parts with two fingers or with a speculum, a straight blunt-pointed bistoury is drawn across the whole of the sore through its centre, going deep enough to divide about a third of the fibres of the external sphincter. Mr. Curling [2] has drawn attention to an important point here, and that is, that the fibres of the muscle at the extremity of the ulcer near the verge of the anus should be divided rather more freely than those above, so as to avoid any ridge or shelf on which the fæces would lodge.

There is usually no hæmorrhage to speak of, and the whole operation is so simple that it may be performed after an injection of

Fig. 326. Section of the anus illustrating operation for fissure of anus. The latter is excised and, in some cases, the resulting wound is closed by a continuous catgut suture which underruns it as shown in the figure.

cocaine, or with nitrous oxide gas, unless anything else, *e.g.* attention to piles, is required. I prefer, however, to operate with ether or the A.C.E. mixture.

Of the two methods, I generally make use of the first, following Mr. Hilton. I consider it the more certain, and have never known of anything like incontinence in the nine cases in which I have used it. The second is rather the slighter operation, and also gives good results.

The position of these usually club-shaped ulcers is posterior. If one is met with anteriorly in a woman, it would be wiser to try the application of acids, or the actual cautery.

The surgeon must be careful, when examining into the amount of repair a week or two later, not to do any damage if a speculum is employed.

[1] This condition, often called a fissure, nearly always amounts to an ulcer when it is carefully examined and the parts unfolded. It is often formed by the tearing down of one of the pouches placed at the junction of the anus and rectum. The strip of mucous membrane which is torn down to the anal margin is often called the sentinel pile (Ball). [2] *Diseases of the Rectum,* p. 12.

B. Operation by Dilatation of the Sphincter. This is not only rough, but uncertain, and should not be employed.

C. Operation by Excision and Suture. To hasten healing, and make it more certain, the whole ulcer, whose base and margins are often firm from long-continued chronic inflammation, is excised down to the muscle fibres, leaving healthy tissues, which are sewn carefully with a continuous catgut suture. Each stitch must run deep to the apex of the **V**-shaped wound, so that accurate apposition of the depth, as well as of the mucous edges, is obtained. If only the mucous edges are joined a fistula may result and time be lost instead of saved by adopting excision instead of incision. Any sentinel pile is also excised.

PROLAPSUS

Indications. Failure of previous treatment. Large size and long duration of the prolapsus. Altered condition of the mucous membrane, viz. thickening or ulceration, the latter giving rise to hæmorrhage. Incontinence of fæces, especially when fluid, or of flatus. It is very rare for any operation to be required in children, for care in dieting, enforced rest in the horizontal position, and proper attention to the bowels, nearly always suffice. Threadworms, rectal polypi, phimosis, or vesical stone must be sought for and treated if necessary.

OPERATIONS. Cautery — Excision — Sub-mucous Injection of Paraffin.

The after-treatment is that given below.

(1) **Cautery.** The position of the patient is as for pile operations, but it is best to apply the cautery to the bowel *in situ*, though this may be used when the bowel is prolapsed.

Thus, the patient being in lithotomy position, and a duckbill-speculum introduced and held in contact with the anterior wall of the rectum, the blade of a thermo-cautery is drawn edgeways along the lower three or four inches of the opposite surface of the gut. The speculum being shifted, the anterior and lateral aspects are similarly treated in severe cases.

Care must be taken not to go *through* the mucous membrane, or septic mischief and sloughing may be set up in the cellular tissue beneath.

(2) **Excision.** In severe cases in adults, when other methods have failed, this method should be resorted to, but even with the improvements of the present day there must always be a difficulty in keeping wounds here aseptic. If the patient be well prepared, the risk of infection from the fæces is greatly diminished, but not entirely abolished. Either portions of mucous membrane only, or, in very severe and intractable cases, the whole prolapse, may be removed.

(i) **Excision of Mucous Membrane.** The patient being in lithotomy position, the prolapsus reduced, and the parts exposed by a duckbill-speculum, two or more elliptical pieces of mucous membrane are removed by pinching them up with vulsellum-forceps and cutting them away with a very sharp scalpel or scissors. Any bleeding vessels are tied, and the edges of the wound united by catgut sutures. Iodoform is then carefully dusted on, and the parts smeared with an ointment of the same.

The insertion of sutures has the advantage of preventing hæmorrhage, and hastening the cure. In some cases the prolapsed mucous membrane is excised much as in Whitehead's operation for hæmorrhoids.

(ii) **Complete Removal of the Prolapse.** Although a more certain cure, this method is much more severe than those already described, and owing to the risk of the operation, should be reserved for cases in which other methods of treatment have failed, the prolapse has become irreducible, or when gangrene threatens.

The operation essentially consists of amputation of the prolapsed bowel, with suture of the divided edges at the margin of the anus.

It must be remembered, however, that a pouch of peritoneum may be present in front between the layers of the prolapsed bowel, and that, in certain cases, a herniated loop of intestine may lie within this pouch. Owing to the vascularity of the parts, considerable hæmorrhage may occur, and, with a view to controlling this, several operators have advised constriction of the base of the prolapse, either by means of specially devised clamps, or by an elastic ligature, applied above transfixing pins, before commencing its removal. The objection to this is, however, the possibility of damage to a knuckle of small intestine lying in a prolapsed peritoneal pouch. Moreover, the hæmorrhage may be satisfactorily dealt with by dividing only small portions of tissue at a time and applying catgut ligatures to the vessels in each portion as they are divided.

The details of the operation have been varied by many surgeons, one of the best methods being undoubtedly that of Mikulicz, which is described as follows by Cumston, of Boston,[1] in a paper containing much valuable information :

" Mikulicz first cuts through the outer intestinal tube in its anterior circumference by cutting the tissues layer after layer, catching up each bleeding vessel as it appears, and ligating it with fine catgut. As soon as the peritoneal pouch has been opened, its interior is examined for the presence of small intestine. The peritoneal cavity is then closed by a running suture. The anterior aspect of the internal intestinal tube is cut through, little by little, until it is opened, and then both intestinal tubes are united by deep silk sutures along the entire line of the incision.

" The posterior circumference of the prolapse is treated in absolutely the same way, both intestinal ends being united by means of silk sutures, and thus the resection is completed."

(3) **Some form of Plastic Operation.** In some cases, when the anus is patulous or the sphincter paralysed or damaged, this may be performed, with the object of narrowing the orifice and, if possible, of restoring the function of a divided sphincter also. Thus Mayo Robson[2] makes a semiliunar incision parallel with the anterior margin of the anus. The wound is deepened for about half an inch and then sutured, so that it runs antero-posteriorly. This narrows the anal orifice very considerably, and tightens the sphincter. The incision may be so placed that a divided sphincter may be reconstructed. The wound is entirely external to the bowel, and in this respect this method is better than excision of wedges from the anal margin.

(4) **Sub-mucous Injection of Paraffin.** In some cases, with paralysed or lost sphincter, this may be found to be of value as in Mr. Stephen Paget's case[3] of prolapse following perineal excision of the rectum.

Mr. Paget[4] thus expresses his views upon this subject :

" I have had only three cases, but the results were so good that the

[1] *Ann. of Surg.*, March 1900.
[3] *Brit. Med. Journ.*, February 14, 1903.
[2] *Practitioner*, February 1903.
[4] *Lancet*, 1903, vol. i, p. 1354.

method certainly deserves consideration. My patients were all over 60 years old. One had prolapse of the bowel after excision of the rectum for cancer, one had prolapse of the bowel of twenty-two years' duration, and one had suffered for twenty-eight years from prolapse of the uterus. I need not say what an amount of misery these three old people represent; and, to my amazement, they have all of them been cured. It is too soon to be sure that they will not need another injection later; but for the present there they are, wholly free from what had seemed incurable troubles. The paraffin, in these cases, must be injected immediately under the mucous membrane of the prolapse, so as to raise and to thicken and to stiffen it and to narrow the passage through which the prolapse comes down. With a prolapse of the bowel I think it is a good plan to take a fold of the prolapse between one's finger and thumb, and to endeavour to make two or three well-defined round masses or hummocks of paraffin which shall form a sort of valve or partial stricture just inside the anus. In a bad case you may have to inject the paraffin at diverse levels and for some distance above the anus. . . . The paraffin must be kept away from the bladder and ureter, and injected mostly under the posterior and lateral folds of the everted mucous membrane."

Mr. Burgess [1] has used this method in 18 cases of prolapse of the rectum, and in one of these there was severe incontinence. He thus describes his method of injecting the paraffin :

" The paraffin I use has a melting-point of 111°, and can be obtained sterilised in small bottles. It is kept melted by placing the bottle in a bath of water at a temperature of about 120° F. The syringe has its barrel covered with rubber to retain the heat longer, but I use no special means to keep the needle hot. The syringe also is placed in the hot water bath for a few minutes, is then filled with the melted paraffin, and replaced in the bath until the moment it is required to be used. The syringe and paraffin can be obtained from Mr. Frank Rogers, of 327 Oxford Street, London, W.

" The following is the technique of the operation which I now perform. The patient is anæsthetised and placed in the lithotomy position, and the prolapse is drawn outwards to the fullest possible extent. I next seize the apex of the prolapse with artery forceps at three points equidistant along its circumference, so selected that two forceps will be placed anteriorly and the third in the posterior median line. By gentle traction on these forceps the assistant then raises the mucous membrane into three ridges, forming an equilateral triangle. The needle of the syringe is inserted in turn into the middle of each side of this triangle, from two to three cubic centimetres of paraffin being introduced on each occasion. As this solidifies it will be found that the mucous membrane has become bulged inwards, encroaching on the lumen of the bowel and converting it into a more or less triradiate slit. The forceps are removed, the apex of the prolapse is reduced, and the mucous membrane is again seized with forceps about one and a half inches from the original apex, the forceps being again placed equidistantly, but this time two are placed posteriorly and the third in the anterior median line. The mucous membrane is again raised into ridges by gentle traction on the forceps, and the needle is inserted midway along each ridge as before, with the result that the lumen of the bowel is

[1] *Lancet,* 1904, vol. ii, p. 759.

again converted into a triradiate slit, the radii, however, corresponding to the intervals between the radii of the tier above. This portion of the prolapse is now reduced, and the forceps are reapplied, this time two being anterior and one posterior, and the process is repeated until the anus is reached. As a rule three tiers are sufficient, but in a very long prolapse more may safely be introduced. In order that any straining on the part of the patient may not cause the prolapse to redescend before the paraffin has firmly set I insert a stout silkworm-gut suture through the buttocks on either side and tie it firmly over a pad of gauze placed over the anal orifice. This suture is removed at the end of twenty-four hours. No special after-treatment is required. The patient is kept in bed for four or five days. The bowels have usually been allowed to act spontaneously.

" *Results.* Of the 18 cases the ages ranged from 3 to 48 years and the size of the prolapse from one and a half to five inches in length. In all of them previously to the operation the prolapse descended with almost every action of the bowels and remained down until replaced. Two were associated with excoriation and ulceration of the mucous membrane. Two had been previously treated by the method of linear cauterisation without success, and two had recurred even after the excision of the lower part of the rectum. The result of the operation has been extremely satisfactory in all the cases, not a single instance of redescent of the prolapse having occurred. One patient left the hospital at the end of a fortnight, but the remainder have all been under observation for at least two months, and several for a much longer period. I have examined the rectum digitally at periods of from one day to six months after the operation, and the paraffin masses can readily be distinguished, feeling like nodules of cartilage or dense fibrous tissue. They do not appear to alter this character within the period specified, at any rate to any appreciable extent."

Comparing this with other methods of treating rectal prolapse, Mr. Burgess claims the following advantages : (1) "It is a simpler procedure, excepting, perhaps, linear cauterisation, and can be more rapidly performed ; (2) it entails practically no risk to life ; (3) no prolonged after-treatment is required, merely keeping the patient in bed for a few days ; (4) the benefit obtained is apparent immediately the paraffin has set, and does not depend upon any subsequent vital phenomena, nor does it make any demand upon the reparative powers of the patient ; (5) it offers a much greater probability of a permanent cure ; and even should it fail the patient's condition is no worse than before, and the procedure may be repeated subsequently."

It is uncertain whether this treatment will find a permanent place in surgery of prolapse of the rectum, for the recorded cases had not been observed for a sufficient length of time at the date of publication to justify us in drawing reliable conclusions from them. Mr. Stephen Paget's cases had only been observed for a few months and, in one of them, Mayo Robson's plastic operation was also performed at the same time. Mr. Burgess's eighteen cases had all been treated within fifteen months of the publication of his paper.

I cannot agree that the treatment is very simple, nor has it been proved that the results are more permanent, although the published results are good as far as they go. Some of the patients treated in this way might have got well with conservative treatment, for at least some of

them were children, who rarely require any operation for prolapse. It is more likely that this method will be found useful when plastic operations are unsuitable or have failed, and when the sphincter is absent or paralysed. Whether the paraffin will or will not sooner or later give rise to any septic troubles when retained in the rectal wall remains to be seen. The author has one very successful case where a man had no control of the anus and had undergone eleven operations. The shelves of paraffin have been very effective for six years and have caused no trouble.

After-treatment. After any operation for prolapsus the patient must rest for three weeks on the sofa to allow of firm consolidation and cicatrisation taking place. Light diet alone should be allowed at first, and the bowels should at first be allowed to act only every three days, and, if possible, while the patient is on his side.

COLOPEXY [1]

For severe prolapse other operations, such as Procotopexy and Colopexy, have been performed ; the former has been followed by too many recurrences, for it is the pelvic colon which often forms the presenting point. Colopexy is more likely to be successful. A long incision is made through the left rectus and the Trendelenberg position is adopted, the small intestines raised and packed off, and the pelvic colon is drawn, thus reducing the prolapse completely. This is not always possible, and in a case of this kind the writer was driven to resect the prolapsed part from the anus. The recto-vesical pouch in the male or the pouch of Douglas in the female is obliterated by catgut sutures passed between the serous coverings of the rectum and bladder or uterus and vagina, and left broad ligament. Then the pelvic colon is sutured to the left psoas and psoas porous, which have been exposed by incising the peritoneum covering their anterior surfaces. The outer edges of this peritoneal incision also are sewn to the outer border of the colon. When the operation is completed the bowel runs downwards, inwards, and to the right along the left lateral wall of the pelvis.

IMPERFORATE ANUS. ATRESIA ANI. IMPERFECTLY DEVELOPED RECTUM (Figs. 327 to 333)

A surgeon, when called upon to explore these cases, will do well to bear in mind the following natural and practical classification, because on this depends his treatment :

Two Main Varieties : A. Cases in which no normal anus exists— **Imperforate Anus.** B. Cases in which a normal anus exists, but the gut is obstructed higher up, or undeveloped—**Imperforate Rectum.**

A. *Imperforate Anus.* (1) Anus partially closed—(*a*) by adhesions of epithelial surfaces, as occasionally happens in the labia of a female infant ; (*b*) by a membrane. (2) Anus completely closed, but only by a membrane. (3) Anus completely closed by a membrane, but a fistula exists—(*a*) on the surface of the body (*e.g.* the raphé of the scrotum) ; (*b*) into the vagina (Fig. 328) ; (*c*) into the urethra or bladder (Figs. 329, 333). (4) Anus imperforate and the rectum deficient as well.

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[1] Lenormant, *Beitr. Z. Klin Chir.*, 1906 and Quenn and Duval, *Rev. de Chir.*, February 10, 1910.

B. *Anus in Natural Position, but the rectum is deficient.*[1] (*a*) The rectum is deficient for a short distance only, and separated from the anus by a cul-de-sac (Fig. 331); (*b*) the rectum is deficient for a long distance, or entirely (Fig. 332).

Treatment. A. **Those in which no natural anus exists.** (1 and 2) If the atresia be due to epithelial adhesions, or to a more or less complete membrane, the former should be broken down and the latter snipped
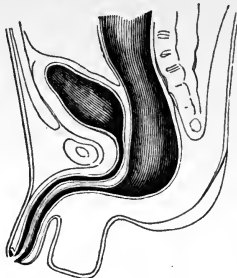
Fig. 327.[2] Anus absent, rectum opening by fistula, close to urethra. (Rushton Parker.)
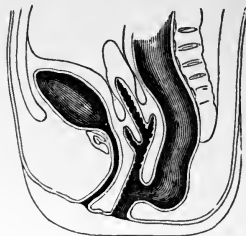
Fig. 328. Anus absent, rectum communicating with vagina. (Rushton Parker.)

away with scissors, and the opening kept patent by a small piece of oiled lint, the nurse's little finger being introduced twice daily.

(3) If the anus be imperforate and the fistula open (*a*) on the surface of the body, (*b*) into the vagina, or (*c*) urethra.

(*a*) A probe is passed from the skin-fistula (*e.g.* in the scrotum) towards the proper anal site ; it is then cut down upon and the opening established in the proper position.
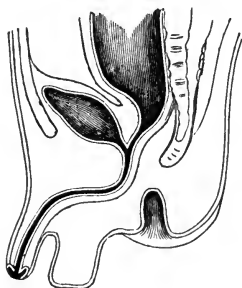
Fig. 329. Anus ending in a cul-de-sac, rectum opening into urethra far back. A case for Littré's operation. (Rushton Parker.)

(*b*) If the fistula open into the vagina, the treatment will vary somewhat with the urgency of the case, the size of the opening, and the age of the child.

Thus if the opening be very small, and the retention urgent, a silver director should be passed through the vaginal fistula back to the proper site of the anus, and there cut down upon. If the bowel is within reach, it should be drawn down and stitched *in situ*. The orifice should be kept patent.

In such a case, though an anus is established in the proper position, it is very doubtful if the vaginal fistula will close, and a further operation will probably be required later on. Plastic operations should not be tried too early, on account of the softness of the tissues and the liquid condition of the fæces.

If, owing to the size of the vaginal fistula, there be not much retention, and especially if the child be not very young, the following operation

[1] As Mr. Holmes has shown, these cases are important, as they are liable to be over-looked till considerable distension has taken place.

[2] This and the next six figures are taken, with a few alterations, from an article by Mr. Rushton Parker (*Liverpool Med. Chron.*, July 1883).

may be performed, after the method of Rizzoli, quoted by Mr. Holmes.[1] An incision is made from the vulva to the coccyx in the middle line, the rectum found by most careful dissection, separated from the vagina, and then brought down and fixed in its natural position. To aid in finding the rectum, a probe should be passed from the fistula.

After the rectum has been brought down and secured the incision between the anus and vulva is united to form a new perineum.
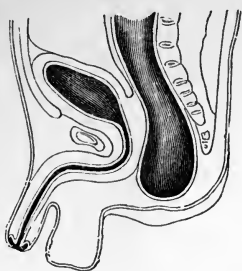
FIG. 330. Anus absent. Rectum could be reached by dissection. (Rushton Parker.)

FIG. 331. Anus ending in cul-de-sac. Rectum readily reached from this. (Rushton Parker.)

(c) Fistula into the urethra or bladder. Two questions here arise : How high up is the communication ? How much of the bowel is deficient ?

If the perineum seems fairly developed, if the ischial tuberosities are not in close contact, if any bulging can be detected at the natural site of the anus, the communication is probably recto-urethral, and an attempt may reasonably be made to find the bowel from the perineum.
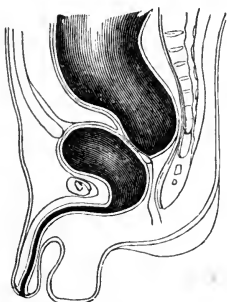
FIG. 332. Anus absent, rectum ending high up. A case for Littré's operation. (Rushton Parker.)
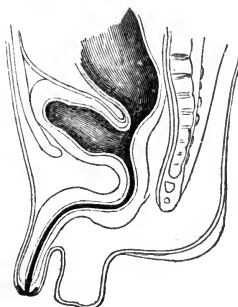
FIG. 333. Anus and rectum deficient, the bowel ending in the bladder. (Rushton Parker.)

If it is found, and can be brought down, an attempt may be made to separate it from the adjacent urethra, but usually the surgeon will have to be satisfied with a free opening, and with keeping this patent, so as to encourage the urethral communication to close. If there appear no probability of the bowel being within reach, or if this cannot be found, left inguinal colostomy should be performed. If the child survive, the bladder must be kept carefully washed out if any fæces still find

[1] *Syst. of Surg.*, vol. iii, p. 788.

their way into it. Thus, in a case of Mr. Clutton's[1] a child about a month old died, sixteen days after Littré's operation, of suppurating kidneys, due to the offensive purulent urine.

(4) Anus absent and rectum deficient as well. Here the chief question is how far upwards an exploratory operation may be safely conducted.

External evidence. Genitals far back and close to the coccyx, and ischial tuberosities close together, point to absence of the rectum.

In most cases the surgeon begins by exploring. The child being under the A.C.E. mixture and in lithotomy position, and a small sand-bag placed under the sacrum, and the bladder emptied with a catheter, the surgeon, seated at a comfortable level, makes a free incision from the position of the anus back to the coccyx. Keeping exactly in the middle line, and opening up the cellular tissue with his finger-tip, aided by a scalpel and director, the surgeon works backwards towards the concavity of the sacrum, constantly taking note with his finger-tip of the depth to which he has got, while an assistant aids in bringing down the bowel by suprapubic pressure.

As a rule, two inches are a sufficient depth in a new-born child. If still in doubt whether to proceed or not, the surgeon may make a careful puncture with an exploring syringe backwards and upwards.

Points to bear in mind. (1) The rectum may end at the brim of the pelvis. (2) If it end lower down, it may be floating with a long meso-rectum. (3) Though the rectum may end within reach, the peritoneum may, and not infrequently does, extend low down on the bowel. (4) Even if the rectum is successfully opened high up without opening the peri-toneum, fatal cellulitis may be set up by the escaping fæces, or by the attempts to keep the bowel patent.

If the above exploratory operation fail, inguinal colostomy should be performed.

B. **Imperforate Rectum.** The treatment here will be an exploratory perineal operation, followed, in ease of failure, by colostomy (p. 248), but in some cases the colon may be found empty or represented only by a fibrous cord. In such cases, the small intestine must be drained as low down as possible.

[1] *St. Thomas's Hospital Reports*, vol. xi, p. 84.

EXCISION OF THE RECTUM

It is important to remember that the rectum extends only from the middle of the third piece of the sacrum, where the pelvic colon ends, to the insertion of the levatores ani at the upper end of the anal canal. It is from five to six inches long and the slit-like anal canal is from one to an inch and a half long. The rectum has no mesentery, and only its upper half is covered by the peritoneum in front. Near the upper end the serous membrane extends to either side of the bowel. Its blood-supply is derived from five arteries—the superior hæmorrhoidal, two middle and two inferior hæmorrhoidals. Of these the first is by far the more important and indispensable, for it supplies nearly the whole rectum, the other vessels only helping to supply the very lower part. The veins of the rectum are similar to the arteries, the greater part of the blood returning by means of the superior hæmorrhoidal and inferior mesenteric to the portal vein. The lymphatic drainage of the rectum is of the greatest importance. P. P. Cole [1] divides its lymphatic networks into (1) the Submucous ; (2) the Subserous ; (3) the Intermuscular and Intramuscular. The important intermuscular lymph vessels are arranged in a circular manner, and this may account for the well-known tendency of carcinomatous growths to encircle the bowel. Cole thinks the spread of carcinoma from the submucous network is along vessels which radiate like the spokes of a wheel and terminate in the intermuscular plexus. From these larger vessels run out into the subserous plexus and the lymphatic trunks and glands behind the rectum. Cole, in twenty cases, did not find any evidence of extensive permeation along the mucous and submucous coats. The lymphatic vessels traverse the pararectal glands and extend upwards behind the rectum to the glands in the pelvic mesocolon, and those on the vessels near the left sacro-iliac joint. These drain into the aortic glands, especially about the inferior mesenteric artery. In striking contrast with this the lymphatic drainage of the anus and anal canal is chiefly downwards and forwards into the inguinal glands, and also partly along the inferior and middle hæmorrhoidal vessels to the internal iliac glands.

Nearly all malignant growths of the rectum are carcinomata, whereas those of the anal canal are squamous epitheliomata. Growths of the rectum spread along the lymphatics in the wall of the bowel both upwards and downwards, but especially upwards and chiefly along the sub-

[1] *Brit. Med. Journ.*, March 1, 1913. This paper records a valuable and laborious research into the microscopic appearance of the parts removed in extensive resections by the abdomino-perineal method.

serous plexus according to Cole.[1] Handley, with the mucicarmine stain, has found what he regards as degenerating cancer cells in the mucosa, extending at least six inches above the primary growth when there has been no change in the naked eye appearances, and he has attributed these to permeation along the lymphatic network of the mucous membrane. Most observers, supported by clinical experience, believe such an extensive spread to be very rare, and Cole asserts that when it occurs the spread is through the subserous plexus and lymph trunks behind the bowel. Mr. A. H. Todd, who carefully examined extensive lengths of bowel removed by me by the abdomino-anal method, found cancer-cells in the bowel several inches above the primary growths. To a lesser degree extension occurs downwards towards the anal canal and occasionally the inguinal glands may be infected. Growths of the rectum also extend laterally into the connective tissues around the rectum and into the neighbouring viscera, such as the prostate, vagina, bladder and uterus, and also invade the sacrum in late cases. The most important line of spread, however, is along the lymphatics into the glands in the pelvic mesocolon. Cole found that the growth had extended into the lymphatic vessels behind the rectum in every one of his twenty cases.

The pelvic peritoneum is often affected and in some cases a widespread infection takes place through the peritoneum. The ovaries may become infected. In some cases embolic infection of the liver occurs, but as a rule this is a late event. It is difficult or impossible to separate growths of the lower part of the pelvic colon from those of the rectum. Indeed, it is common to find the growths at the junction of the rectum and pelvic colon. Therefore, growths of the lower part of the pelvic colon will be considered with those of the rectum.

Indications. Apart from malignant disease it is very rarely necessary or wise to attempt excision of the rectum. Carcinoma of the rectum is mostly slow growing and long remains localised to the pelvis, but the lymphatics and connective tissues behind and at the side of the rectum are soon invaded by minute collections of cancer cells too small to be appreciated except with the microscope. These and the lymphatic glands in the pelvic mesocolon can be removed in one mass with the primary growth in the bowel. Similarly extensions of growth up and down the bowel, which are rarely extensive, can be overcome by wide resection. Therefore, *removability depends chiefly on the amount of mobility of the growth and the probability of freedom from invasion of important local structures*, such as the bladder, prostate, urethra or ureters. It is a melancholy fact that a very large proportion of growths of the rectum when the patients first come to the surgeon are inoperable usually on account of invasion of important structures in the pelvis. In most of these cases a timely and routine examination of the rectum with the finger whenever abdominal or pelvic symptoms are present, should have led to a correct diagnosis. It is important to remember that a high growth often becomes palpable when the patient is in the sitting-up position and straining, and counter-pressure is made above the pubes. In some high growths and especially those of the pelvic colon, the sigmoidoscope is necessary and should be used when there is any suspicion. It is not always easy to estimate the amount of local extension. The

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[1] *Brit. Med. Journ.*, April 16, 1910.

sigmoidoscope is often of value in deciding on the mobility of growths which are too high for thorough examination with the finger. In many cases an anæsthetic is necessary. The part where it is most difficult to estimate the mobility is in front in the neighbourhood of the bladder, prostate and urethra. As regards the bladder, mere adhesion of the growth to it is not a bar to resection, for portions of the peritoneal and muscular coats may be safely removed, but if the mucous membrane is involved it is not wise to attempt an operation, for the invasion is generally at the base of the bladder, and a satisfactory control of the latter is difficult to obtain under these circumstances. The extent of this invasion can be best judged by means of the cystoscope, which should be used when there is any doubt. When a recto-vesical fistula has formed it is obviously too late to operate.

Invasion of the prostate is not so grave, for the greater part of this gland can be removed with the growth. Invasion of the urethra is more serious, and is shown by difficulties in micturition and passing a catheter. The left ureter has to be very carefully separated from the growth in some cases.

Invasion of the vagina or uterus, although serious, is not a bar to operation, for these structures can be removed together with the growth in the rectum. Similarly invasion of the sacrum, if low down, and the sacral plexus is free, can be dealt with by resection of the bone. Invasion of the ovaries is more serious, for it generally means that cancer cells have been discharged into the peritoneum and a widespread but less obvious infection of other viscera may already have taken place. When the growth is late and adherent, the danger of excision and the risk of early recurrence are greatly increased, but sometimes the patient decides to take his chance in preference to the certainty of a miserable existence with or without colostomy. Sometimes evidence of peritoneal infection can be found in the form of a hard shelf of deposit at the bottom of the recto-vesical or utero-vesical pouch, and this can be felt on pelvic examination. This is an absolute bar to operation. Although embolic infection is rare, the liver should be very carefully examined in all cases, for in some the pelvic growth may be freely movable and yet the liver be affected. With the abdominal wall well relaxed and the patient taking deep inspirations, the edge of the liver may be noticed to be hard and irregular or nodules may be felt on its anterior surface. Sometimes these growths may not be feelable until the patient is under an anæsthetic, and unfortunately a multitude of minute growths in the liver may not be palpable until the abdomen is opened. In the majority of cases full information is not obtained as to the operability of the growth until the abdomen has been explored, and in the large majority this should be the first step in the operation. The hand is first passed above both lobes of the liver, for here early embolic growths are most commonly felt. Next the hand is swept down along the aortic glands. If these are hard and considerably enlarged resection of the primary growth is rarely indicated, except perhaps as a means of giving greater comfort than colostomy or leaving alone. Similarly the iliac glands are felt, and then the mobility and connections of the primary growth are carefully examined. Often a growth, which from below seems to be fixed, proves to be fairly movable when it is examined from above. Finally, the age and condition of the patient are to be carefully considered, for resection of the rectum is a serious operation, which cannot be borne by very old or very

feeble patients. Age is, of course, not to be judged by years alone but by the condition of the viscera and the general vigour of the patient, but it is rarely wise to attempt an extensive resection after 65. Anæmic or cachectic patients do not stand these operations well, and in very stout patients the mechanical difficulties of a combined abdominal and perineal operation are very considerable. A man of this type is far more difficult to deal with than a woman on account of the smaller space available in the pelvis, and the greater proximity of the male bladder and urethra to the growth. In some of these bad subjects a local perineal or sacral resection may be well borne, when a combined operation would be very risky. In these cases the advantages of an abdominal exploration are not always available, on account of the added danger involved, and therefore it is possible that occasionally resection may be undertaken in the presence of secondary growths in the aortic glands or liver.

Whenever possible without undue risk excision of the rectum should be chosen in preference to colostomy, for although the mortality of excision is much greater than that of colostomy, the average duration of life after it and the amount of comfort given by it when well performed are much greater. Thirty per cent. of Mayo's cases were free of recurrence five years after the operation.

CHOICE OF·OPERATION

When considering the choice of operation it is wise to bear in mind certain principles which are of great importance.

(1) All the tissues which are reasonably likely to be diseased must be removed *en masse* with the primary growth. At least four inches of the bowel above and two inches below must be removed together with the lymphatic vessels and loose connective tissues behind and at the sides of the rectum. The lymphatic glands high up in the pelvic mesocolon also must be removed, a clean sweep being made of all the soft parts in front of the sacrum. This is not easily done by any perineal or sacral operation.

(2) Asepsis must be maintained, for as Mayo has shown, 90 per cent. of deaths after excision of the rectum are due to sepsis. Therefore, the bowels must be well cleared out for several days before the operation or, when this is impossible, a preliminary colostomy must be performed so that the lower bowel shall be clean at the time of the operation. For the same reason great care must be taken to avoid opening or dividing the bowel in the pelvis during the operation except when absolutely necessary, and then the stumps should be sterilised with the thermo-cautery. Whenever possible the division and suture of the bowel should be done outside the body and towards the end of the operation. With the same object the anus is sutured or tied at the beginning of the operation.

(3) *The Preservation of the Blood-supply* of the parts to be joined is of the greatest importance, and with this object a careful study of the blood-supply of the rectum has been made by Sudeck,[1] Hartmann and de Dietriech [2] and Davis.[3] Nearly all the blood-supply of the rectum is derived from the superior hæmorrhoidal artery. This divides into two

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[1] *Münich. Med. Woch.*, 1907, p. 13.   [2] *Ann of Surg.*, December 1909.
[3] *Ann. of Surg.*, vol. ii, 1910, p. 529.

main branches as it descends in the pelvic mesocolon. These branches run down on either side of the back of the rectum and soon pierce the muscular wall and run in the submucous tissue as far as the anus, in their course anastomosing with the middle and inferior hæmorrhoidal arteries on either side, which, however, are not to be relied upon to nourish more than the very lower end of the rectum and the anal canal. Complete excision of the rectum with its lymphatics and glands is impossible without high division of the superior hæmorrhoidal artery. The lower part of the pelvic colon and the upper end of the rectum are supplied from the lower sigmoid artery and an anastomotic loop which runs down, generally close behind the bowel, from this to the superior hæmorrhoidal, or sometimes to the posterior or right branch of the latter
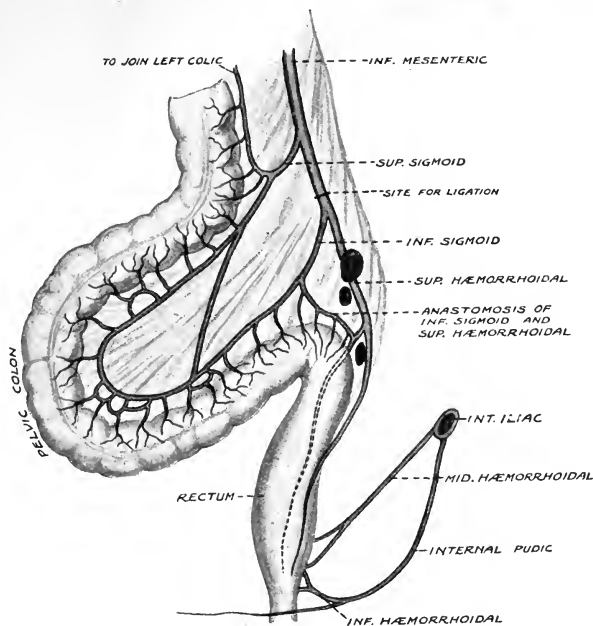
Fig. 334. The arterial supply of the pelvic colon and rectum.

(see Fig. 334). Sometimes the lower part of this loop is mistakenly called the lower sigmoid artery. It is clear that the best place to tie and divide the artery is an inch above the union of this loop of the lower sigmoid artery to the superior hæmorrhoidal, for in this way the valuable anastomosis between the lower sigmoid and superior hæmorrhoidal artery is preserved. *This anastomotic loop is almost constant and is found a little below the sacral promontory.* Unfortunately, it is almost impossible to tie the main artery above this anastomotic loop by any perineal or sacral operation, nor is it possible to identify the vessels with accuracy. This makes it impossible to guarantee a good blood-supply to the recto-pelvic junction in these operations; also when the artery is tied lower down the pelvic loop cannot be straightened out to allow the colon to be brought to the anus without tension.

(4) *Restoration of Function.* Whenever possible without sacrificing

the other principles, we should endeavour to restore the natural function, and an early diagnosis and operation make it possible to do this in selected cases, the pelvic colon being brought down to the anus and the controlling apparatus completely saved. With more extensive disease complete excision of infected parts compels us to remove the muscles of the pelvic floor and sphincters, and then to adopt permanent colostomy. This should be conveniently placed and made as controllable as possible.

Careful study of the pathology of carcinoma of the rectum shows that for a good hope of radical cure it is necessary to remove the whole of the rectum together with its lymphatics and glands in the pelvic mesocolon. No perineal or sacral operation allows the satisfactory removal of this extensive area without endangering the blood-supply of the bowel to be brought down either to the anus or to the sacral region. A free view from the abdomen is necessary for the proper examination of the vessels, so that the latter can be tied at the most advantageous spot. Moreover, a complete removal of infected glands is far more certain and easy from above. Further, an abdominal exploration is the only certain way of finding out the operability of the growth and proving the absence of disease in the liver and aortic glands. Therefore it is clear that some form of combined abdominal and perineal excision is the ideal from the pathological point of view, and this should be done in the majority of cases which are suitable for excision, for local recurrence is far too common after perineal and sacral resection. In many doubtful cases the abdominal exploration will prove in a few minutes that resection is either impracticable on account of invasion of important structures, or inadvisable on account of secondary nodules in the liver, a condition which the writer has found more often than he expected with a movable primary growth. It is not so easy to decide which type of combined operation to adopt in any given case. There is no advantage in combining the abdominal and sacral routes unless the growth is adherent to the sacrum or coccyx. Otherwise sacral completion of the operation is far more dangerous and tedious than the perineal or anal. The difficulty is in deciding between (1) *the abdominal;* (2) *the abdomino-perineal* and (3) *the abdomino-anal* methods.

(1) When a growth in the pelvic colon can be widely removed without trespassing on the rectum or damaging the blood-supply of the latter, end-to-end union may be made by direct suture with or without the aid of the tube method. When this is practicable much time is saved and perfect function is restored, for the structures of the pelvic floor are not disturbed.

(2) With the abdomino-perineal method a permanent inguinal colostomy is adopted and is regarded as the price paid for a greater chance of immunity from recurrence, but as yet there is no adequate proof that recurrence is less common after it than after the abdomino-anal operation, which is incomparably better from a functional point of view, a controllable anus in the natural position being obtained. Four out of twenty-five of Mr. Miles's patients had recurrence after his abdominoperineal operation.

(3) Surely there is a great advantage in preserving the pelvic floor and the sphincters by the abdomino-anal method in suitable cases, but it is not safe to do this when the growth is so low down or so late as to

risk the probability of infection of the pelvic floor. I believe that the future will show the ideal operation to be the abdomino-anal. There is no reason why the removal of the glands and bowel above and below the growth should not be as extensive as by the abdomino-perineal method, and then the lower end of a well-nourished colon can be brought to the anus after *free mobilisation of the ascending colon*. *But the abdomino-anal operation is clearly unsuitable for very low, extensive, rapidly growing, or late growths, for an attempt to save the pelvic floor and sphincters in them would almost certainly lead to local recurrence.* With a proper selection of cases and free removal of the cellular tissues and glands in front of the sacrum, local recurrence ought to be extremely rare, after the abdomino-anal operation. Should it occur and obstruction develop, secondary colostomy can be performed. The abdomino-perineal is clearly to be chosen when there is a probability of invasion of the pelvic floor and also for those very malignant growths which sometimes come in young people and grow and spread with great rapidity. So far the mortality of the combined operations in old and feeble patients has been too great ; therefore, in most patients over 65 with growth in the middle or lower part of the rectum, some form of perineal or sacral removal should be considered as an alternative, for these operations carry a much lower mortality and yet offer a fair, if less, chance of freedom from recurrence and relief from symptoms. In old women who are feeble, anæmic or very fat, the perineal or vaginal operation is the most suitable and provides a fair amount of room. In men of a similar type the sacral route gives more room. In most of these the abdomen should be explored to ascertain the condition of the liver, glands, extent and mobility of the growth in the pelvis. This can be done through an opening near the middle line only large enough to admit a hand. Epithelioma or melanoma of the anus is best removed by the limited perineal operation of Cripps and Allingham.

PRELIMINARY COLOSTOMY BEFORE EXCISION OF THE RECTUM

Theoretically this preliminary step would seem very desirable, especially if the infective fæces are completely diverted so as to lessen the chances of infection during the severe operation in the pelvis. Lateral colostomy with incomplete diversion is not so satisfactory but has a lower mortality. Kraske, Quénu, Keen, Hartwell, Mayo and many others are in favour of preliminary colostomy. There is no doubt that a colostomy opening in the left groin makes the resection more difficult and less clean, but a very high colostomy or one in the transverse colon may overcome this difficulty. Preliminary colostomy adds considerably to the duration of the patient's illness, for the resection is not wisely undertaken under about ten days after the colostomy, and the closing of the fistula later on, if desirable, may take an indefinite time. Several anæsthetics may have to be taken, but the colostomy may be done under local anæsthesia. Hartwell believes that the combined mortalities of complete preliminary colostomy and resection would be lower than that of resection without preliminary artificial anus. The chief objections to a preliminary colostomy are that it causes loss of valuable time without a compensating advantage, since, with careful preliminary evacuation of the bowel and careful operative technic, the operation and the after-course are satisfactory; that it saps the patient's

strength and so diminishes his power of standing the more severe operation; and that, by fixing the bowel above it may interfere with its mobility, thus preventing it from being efficiently pulled down at a second operation. Moreover, a third or even a fourth operation may be required to close the artificial anus after the new rectum has soundly healed. Finally, as remarked by Sir Charles Ball, the advantages of retaining a fæcal outlet in the perineum are great, so long, of course, as this is not contracted.

It would seem, therefore, that the wisest course lies in reserving colostomy for (i) those cases in which there is either declared or threatened obstruction, preventing the proper evacuation of the bowel before the growth is excised; (ii) cases in which it is fairly certain that it will never be possible to secure a controllable anus in the natural position. An inguinal artificial anus is preferable and more under the control of the patient than a sacral one, and it is far better than a long fibrous stricture, or the ulcerating track, devoid of any control, which so often follows an unsatisfactory perineal excision. I have seen patients whose lives have been very miserable under these conditions, and who have been greatly relieved by a secondary colostomy.

The following methods will be described :

(1) **Local Resection.**
(2) **Perineal Excision.**
    (a) *The limited method of Allingham and Cripps.*
    (b) *The Quénu-Tuttle Method.*
(3) **Excision of the Rectum by the Vagina.**
(4) **Sacral Excision.**
(5) **Abdomino-Perineal Excision.**
(6) **Abdomino-Anal Excision.**
(7) **Abdominal Resection.**

(1) **Local Resection.** Excision of the growth with only a part of the circumference of the bowel should be reserved for the rare cases where the disease is discovered early and is very small and superficial, admitting of extirpation together with a wide margin. Mayo reports five such cases with freedom from recurrence, and the writer removed a papillary carcinoma from the rectum of a feeble old lady who had no sign of recurrence five years later. Such an operation may be undertaken in a very old or feeble patient, who is utterly unsuitable for a radical operation. In such a patient a growth which forms the presenting part of an intussusception, or a growth limited to one aspect of the rectum, may be capable of withdrawal through the dilated anus. In such cases, which are early ones with unusual mobility and freedom from invasion of neighbouring tissues, the intussuscepted mass can be resected, and the remaining healthy ends joined together after Maunsell's method, but the lymphatic glands cannot be removed. The late Mr. Allingham thus condemns partial operations : " The partial removal of the circumference of the bowel is, in my opinion, most unsatisfactory. In all the cases in which I have removed only part of the wall there has been either a return of the disease in the rectum, or in the glands in the groin, or in some internal organ, mostly the liver."

(2) **Perineal Excision.** (a) *The limited operation of Allingham and Cripps.* This is generally done for epithelioma of the anus. An elliptical

incision is made round and about an inch and a half away from the anus. The anal canal together with the sphincters and the soft parts in the ischio-rectal fossæ are removed. The levatores ani are divided well away from the growth, and the bowel is divided at least one inch above the upper margin of the growth. A sound in the urethra or finger in the vagina forms a valuable guide and prevents injury of these parts. All bleeding vessels are tied and the wound is packed with gauze, for the bleeding may be furious. No attempt is made to bring the rectum down to the anus, for this only leads to sloughing. Mr. Cripps considers that any attempt to bring down the cut edges of the rectum, and to. stitch them *in situ* around the anus, is perfectly useless, as the sutures are certain to cut their way out, and harmful, as likely to prevent the escape of discharges. As this entails the very serious risk of septicæmia, the advantage which suturing the bowel would give, if it were safe, of preventing subsequent contraction has been put aside. On the other hand, Volkmann, Czerny,[1] and others have recommended the use of sutures so as to hasten healing and obviate the tendency to stricture. If they are employed, they must be passed as advised by Ball, not only through skin and bowel, but also deeply through the surrounding pelvic structures as well. Mr. Bidwell [2] recommended the following plan to enable the edges of the wound to be brought together. Two transverse incisions about two inches long are made on each side of the perineal incision. The flaps of skin so formed are then dissected up and attached to the cut edge of the rectum by means of silkworm-gut sutures. As a rule, this can be carried out without undue tension, but should there be any, a longitudinal incision in the posterior surface of the rectum will enable the union to be effected. Fairly good control is obtained if stricture is prevented by the diligent use of bougies especially from the third to the sixth week. The inguinal glands on both sides, whether enlarged or not, must be removed. It is best to do this at the beginning of the operation, so that the extensive wounds in the groin are not so liable to septic infection as when the step is deferred until after the growth has been removed. When the patient is feeble the glands may be removed either a week before or a week after the resection of the anal growth.

(b) *The Quénu-Tuttle Method.* When the growth is well above the anus so that the external sphincter can be saved it is better to adopt the Quénu-Tuttle method.[3]

The patient is anæsthetised and placed in the lithotomy position with the pelvis slightly raised. The rectum is cleansed, dried, and loosely packed with gauze so that its wall may be easily recognised and avoided during the later stages of the operation. The vagina is also washed out and the bladder emptied. An incision is made close to and around the anus, and the mucous membrane of the anal canal is dissected up for about half an inch, where it is firmly tied by means of a strong silk ligature, and the end of the stump is sterilised with the cautery. The ends of the elliptical incision are then continued backwards as far as the tip of the coccyx and forwards into the perineum nearly as far as the scrotum. The fibres of the external sphincter are separated

[1] *Loc. supra cit.*
[2] *Brit. Med. Journ.*, October 21, 1899.
[3] Quénu, *Rev. de Gynécol.*, September 1898 ; Tuttle, *Diseases of the Rectum and Colon*, 1903.

and divided exactly in the middle line anteriorly and posteriorly, and drawn aside with the skin (Fig. 333).

The posterior wound is deepened and the rectum is freed upon its posterior and lateral aspects, the levator ani being divided close to the rectum (Fig. 334). The anterior fibres are divided last after being isolated by passing the finger forwards and upwards close to the rectum (Fig. 334). By blunt dissection the rectum is then freed from the sacrum, and from the loose pelvic cellular tissues upon its lateral aspect.

The separation of the bowel in front varies with the sex of the patient. In a male, a full-sized metal sound having been passed into the bladder and kept well hooked up under the pubes, the surgeon carefully
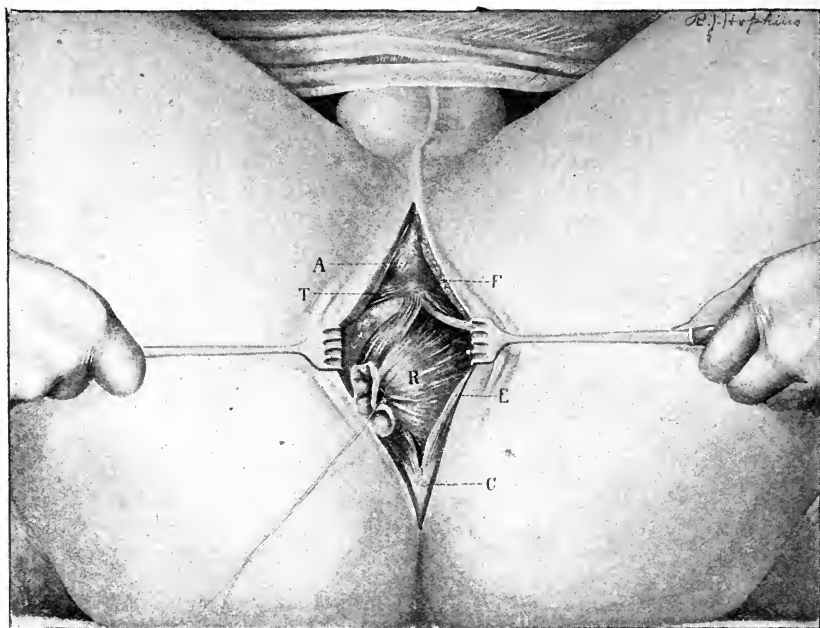
FIG. 333. Perineal extirpation of the rectum (Quénu's method). R, rectum; E, external sphincter; C, coccyx; T, transversus perinæi muscles; A, bulbous urethra. (Tuttle.)

dissects partly with his finger and partly with scissors, between the bowel and urethra and prostate. These parts are naturally adherent, and this dissection must be carefully conducted, as any opening into the bladder or urethra or injury of the ureters is a serious matter. As it is freed the bowel is drawn backwards and downwards so as to afford a good view of the depth of the wound (Fig. 335); disarticulation of the coccyx, which is then folded backwards, facilitates this procedure.

In the case of a woman the surgeon's left index, or the finger of an assistant in the vagina, will give the best warning of his knife or scissors (the latter, long and blunt-pointed, are preferable) getting too near the vaginal mucous membrane. If this be encroached upon, it must be
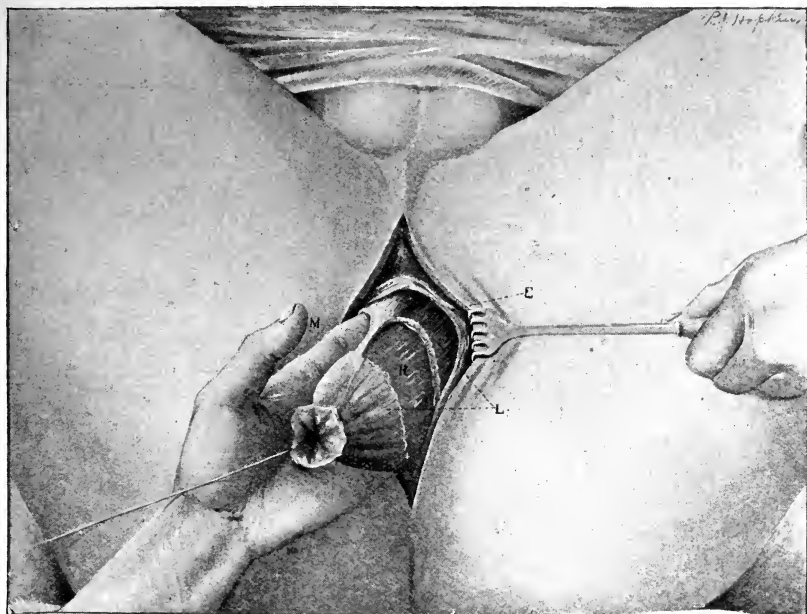
Fig. 334. Perineal extirpation—loosening rectum from anterior perineal raphé. L, levator ani ; R, rectum ; M, raphé.   (Tuttle.)
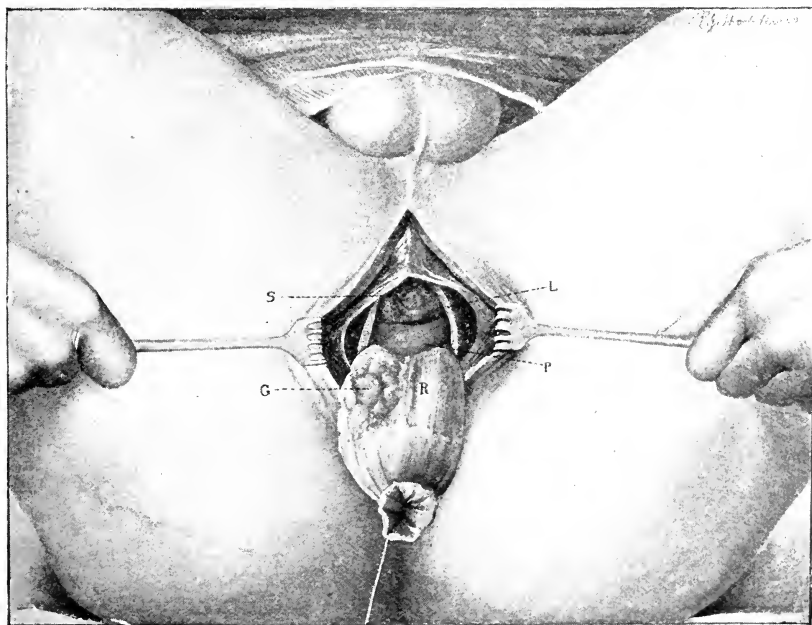
Fig. 335.   Perineal extirpation.   R, rectum ; L, levator ani ; G, neoplasm ; P, peritoneal pouch ; S, seminal vesicles and prostate.   (Tuttle.)

removed without hesitation, and the opening thus made closed towards the end of the operation (p. 801).

On continuing the dissection upwards the peritoneal pouch in front of the rectum is displayed. In some cases, when the growth does not extend beyond this pouch, it is possible to avoid opening the peritoneum by displacing the peritoneum upwards by blunt dissection. In the majority of cases, however, it is best to open the peritoneum at its lowest point (Fig. 336), and then to continue the incision to either side close to the rectum until the mesorectum is reached. This is divided close to the sacrum so that it can be drawn downwards with the bowel. This avoids the risk of dividing the superior hæmorrhoidal artery at this
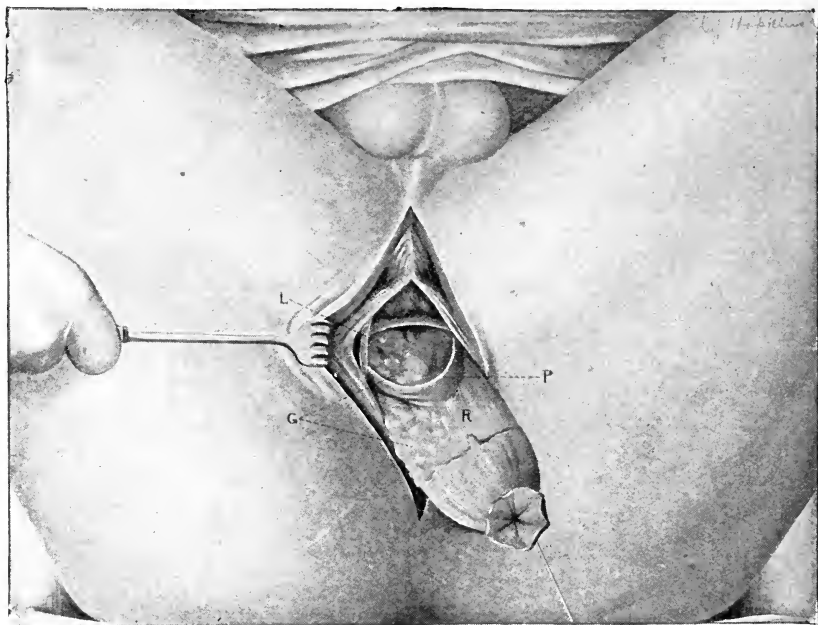
Fig. 336. Perineal extirpation—the peritoneal pouch laid open. (Tuttle.)

stage in the depth of the wound, and also enables the surgeon to remove the glands within the mesorectum.

The small intestines are packed away with gauze, which also serves to collect any blood which tends to gravitate towards the abdomen when the pelvis is elevated. The rectum is separated freely enough to allow the growth to be drawn well out of the wound, and the bowel at least an inch above the disease to be brought down and sutured without tension to the anal skin. The superior hæmorrhoidal artery is tied and divided. The parietal peritoneum is then sutured to the serous covering of the rectum, with the double object of closing the peritoneal cavity as far as possible and lessening the tendency to retraction. Next the edges of the levator ani are sewn together and to the side of the rectum ; this serves to re-constitute the pelvic floor, to limit retraction and do away with the dead space, which otherwise tends to fill with blood or serum and to get infected.
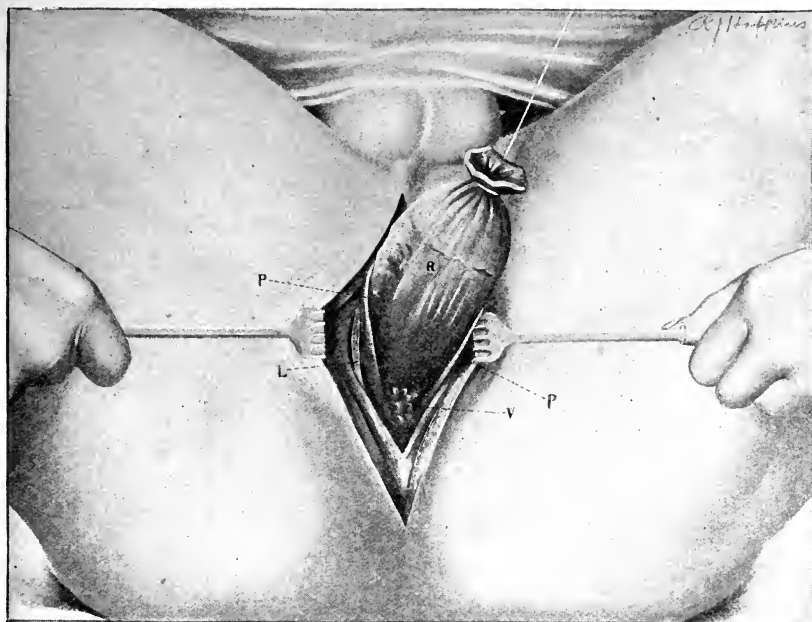
FIG. 337. Perineal extirpation. P, lateral peritoneal folds ; V, glandular enlargement between folds of meso rectum. (Tuttle.)
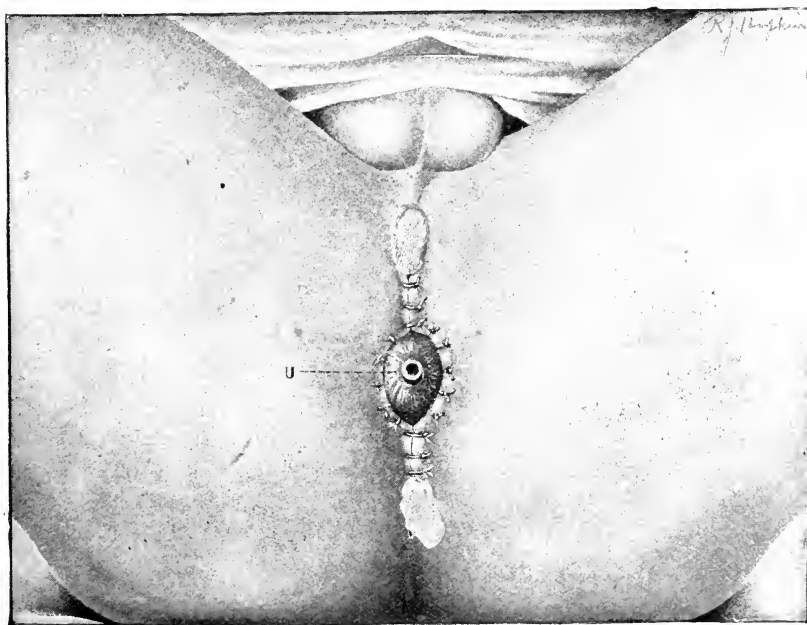
FIG. 338. Perineal extirpation completed. U, tampon and drainage-tube in anus. (Tuttle.)

The bowel is drawn down and clamped well above the growth with long curved intestinal forceps, the handles of which are below or behind. These prevent any leakage, retraction, or hæmorrhage during the next stage. The rectum is cut across one-third of an inch below the forceps and at least one inch above the disease. The margin is then accurately joined to the anal skin, with numerous interrupted silk sutures, which pierce all the coats of the rectum and secure a good hold.

The anterior and posterior wounds are closed near the rectum by sutures which pass deeply and bring the divided ends of the external sphincter together. The wound is drained, and a tube is passed into the rectum (Fig. 338).

(3) **Excision of the Rectum by the Vagina.** This method was introduced by Norton,[1] and advocated by Campenon[2] and Rehn.[3] More recently it has been successfully used and recommended for certain cases by Murphy and others. It is chiefly indicated when the vaginal wall or uterus is adherent to the growth. The following description is based upon Tuttle's modification of Murphy's method.[4]

The patient is carefully prepared in the usual way, and placed in the lithotomy position with the pelvis slightly raised. The vagina is dilated with broad retractors. Unless the growth is very low down, the peritoneum must be opened, and this step greatly facilitates the liberation of the growth (*see* Fig. 339).

The cervix is drawn downwards and forwards with tenaculum forceps, and the pouch of Douglas opened transversely just below the cervical reflection, and the intestines packed away with gauze. A vertical incision is then made through the posterior vaginal wall in the middle line, extending from the first incision to the anal margin. The mucous membrane of the anal canal is isolated as in Whitehead's operation and ligatured to prevent any leakage during the later steps of the operation. The posterior vaginal wall is dissected off the rectum, great care being taken not to open the bowel. This accident is most easily prevented by beginning the separation above at the peritoneal reflection. If any of the vaginal wall is involved, it must be sacrificed.

When the anterior surface of the rectum has been cleared, the lateral peritoneal reflections and the serous coverings of the mesorectum are divided as already described (p. 798). Then the bowel can be more easily drawn forwards and downwards, while the posterior surface together with the lymphatic glands are separated from the sacrum by blunt dissection. If necessary, this dissection may be carried up as high as the promontory of the sacrum, in order to bring healthy bowel well above the growth, to the anal margin, without tension. To allow this, the superior hæmorrhoidal artery has to be tied and divided a little below the selected line of section of the bowel above the tumour. The rectum is then drawn down and the peritoneum closed by sutures or gauze packing, or both. When this essential step has been taken, the intestine is divided between two clamps at least three inches above the upper limit of the disease. When the growth has been removed, all bleeding vessels are secured, and the upper end of the bowel below the clamp forceps is sutured to the anal margin with numerous catgut or silk sutures.

[1] *Trans. Chir. Soc.*, 1890.　　　　　　　　[2] *France Médicale*, 1894.
[3] *Cent. f. Chir.*, 1895, No. 10.
[4] Tuttle, *Diseases of the Rectum and Pelvic Colon*, 1903.

In some cases it may be possible and wise to preserve some of the lower segment of the rectum, and to join the upper end to this, but the risk of leakage and infection of the wound is greater by this method, and it is therefore better to complete the operation after Moulonguet's method as described above, although this involves freer separation of the upper part of the bowel. In any case there must be no tension upon the sutures, and the blood-supply must be satisfactory, or sloughing is bound to ensue.
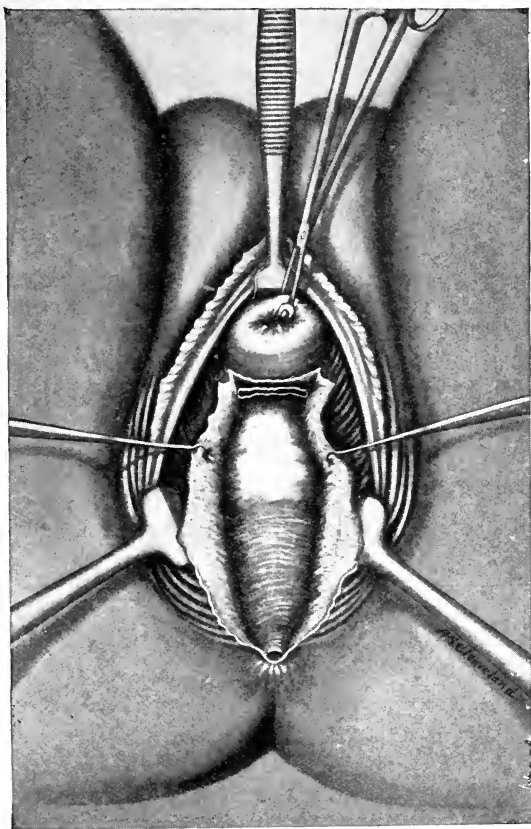
Fig. 339.   Separation of rectum from vaginal walls.   (Murphy.)

The vaginal wall and the perineum, including the external sphincter ani, are carefully sutured with catgut.

An incision may be made between the coccyx and the anus, and a drainage-tube introduced through the pelvic floor into the hollow of the sacrum. This will be all the more necessary if end-to-end union above the levator ani has been adopted.

The results of the vaginal method have been good. Out of 23 cases collected by Tuttle only three died as the result of the operation (14·3 per cent.). The method is most suitable for growths low down and adherent to the vagina.

(4) Sacral Excision. *Kraske's Operation and its Modifications.* Kraske, of Freiburg,[1] introduced this route as best adapted for those cases which, in Volkmann's words, are situated too high for the perineal route and are too low and too fixed to admit of removal by abdominal section. The patient is carefully prepared and placed on his face with the pelvis well raised and the thighs flexed. A tampon of gauze may be left in the rectum for localising purposes, but too large a mass
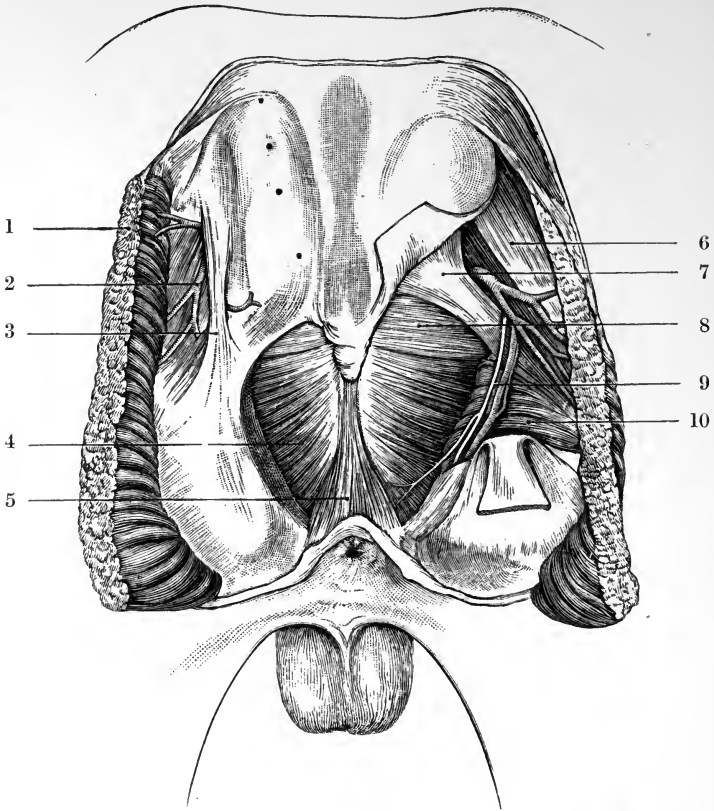
FIG. 340.

From a dissection made by Mr. E. H. Taylor.

The black dots over the sacrum indicate the levels of the first, second, third, and fourth posterior sacral foramina.

1. Gluteus maximus muscle.
2. Sciatic artery.
3. Great sacro-sciatic ligament.
4. Levator ani.
5. Sphincter ani externus.

6. Pyriformis muscle.
7. Lesser sacro-sciatic ligament.
8. Coccygeus muscle.
9. Internal pudic artery and pudic nerve.
10. Obturator internus muscle.

obscures palpation of the diseased part from the incision. The anus is sutured and every care must be taken not to open the bowel during its liberation. An incision is made in the middle line from the posterior edge of the anus to the upper third of the sacrum, the knife being carried down to the bone at once. The soft parts are raised and then turned

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[1] *Arch. f. Klin. Chir.*, Bd. xxxiii, S. 563.

outwards, including a part of the gluteus maximus, and exposing the sides of the sacrum and the sacro-sciatic ligaments. These last must be divided and detached from both sides of the coccyx and lower part of the sacrum, together with the coccygeus, part of the left pyriformis and, if the anal region is to be removed, the sphincter and levator ani. With a periosteal elevator passed under the sacrum the soft parts are now detached from the hollow of this bone, including the sacra media vessels and
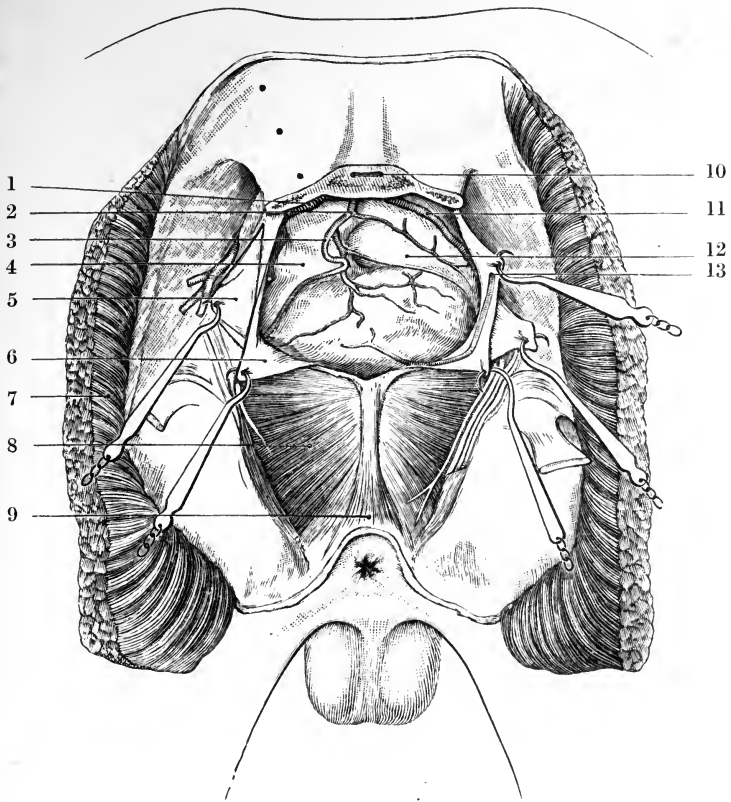
Fig. 341.

From a dissection made by Mr. E. H. Taylor.

The black dots over the sacrum indicate the levels of the first, second, and third posterior sacral foramina.

1. Lateral sacral artery.
2. Middle sacral artery.
3. Superior hæmorrhoidal artery (left main division).
4. The pelvic peritoneum.
5. Lesser sacro-sciatic ligament.
6. Pelvic fascia.
7. Gluteus maximus muscle.
8. Levator ani.
9. Sphincter ani externus.
10. Sacral canal.
11. Lateral sacral artery.
12. Rectum.
13. Middle hæmorrhoidal artery.

a venous plexus, thus avoiding troublesome bleeding. With sharp and powerful bone-cutting forceps the sacrum is divided just below the third sacral foramina so that the third sacral nerves are not injured. The section is concave, a little more of the centre of the bone being removed, but without opening the spinal theca.

Haske only removed the coccyx and the left side of the fourth and fifth pieces of the sacrum ; but this did not give enough room.   The osteoplastia flaps are apt to necrose, and to limit the view.   The bleeding up to this time, which is largely venous, is best met by firm gauze pressure ; much time will be lost in attempting to seize the bleeding-points in the usual way.   As soon as the bone is out, the vessels may be closed by forci-pressure or, where needful, by underrunning.   The hæmorrhage comes
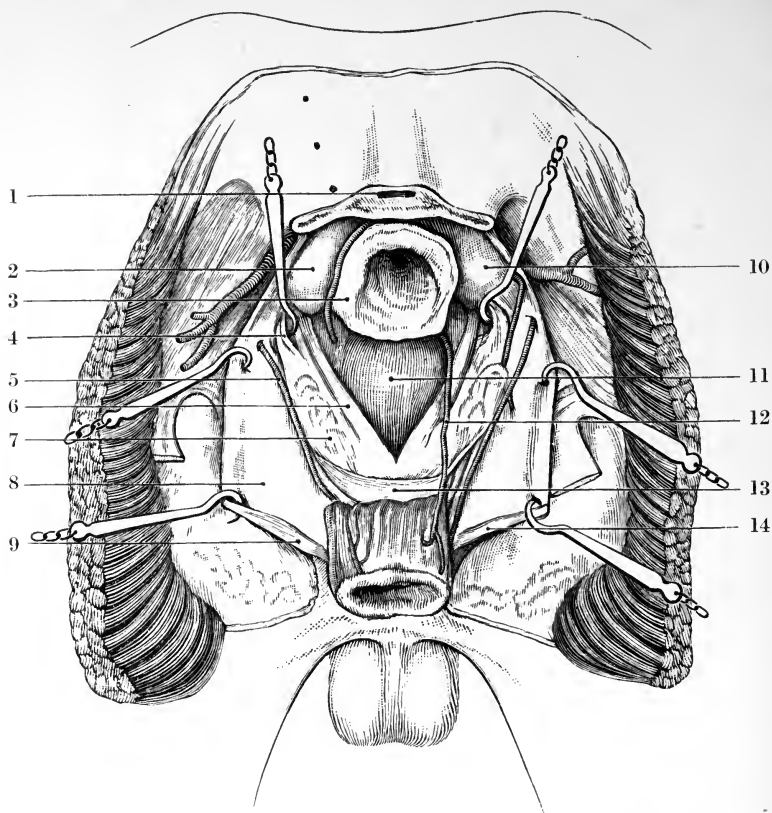
FIG. 342.

From a dissection made by Mr. E. H. Taylor.

The black dots over the sacrum indicate the levels of the first, second, and third posterior sacral foramina.

1. The sacral canal.
2. The pelvic peritoneum.
3. The rectum.
4. The ureter.
5. Middle hæmorrhoidal artery.
6. Vas deferens.
7. Seminal vesicle.
8. Pelvic fascia, clothing the upper surface of the levator ani.
9. Cut surface of the ano-coccygeal raphé.
10. The pelvic peritoneum.
11. The bladder.
12. Superior hæmorrhoidal artery (right division).
13. Pelvic fascia (recto-vesical layer).
14. Cut surface of the ano-coccygeal raphé.

chiefly from the lateral and middle sacral, the hæmorrhoidal arteries, the bone itself, and a venous plexus on both aspects of the sacrum.   The pelvis is, in this way, freely opened, and from six to ten inches of the bowel may be removed.   The tissues, down to and including the levatores ani,

are now divided along the median raphé behind, and the separation of bowel commenced. If the growth does not reach to within two inches of the external sphincter, this, together with the anus, is left intact; if, on the other hand, there is any suspicion that the external sphincter and anal region may be involved by the growth, these must be removed. Unless matted by extension of the disease, the bowel will readily be shelled out of its bed, posteriorly and laterally. On continuing the blunt dissection at the upper end of the wound the peritoneal reflection will be reached on the anterior wall. This is freely opened at once. It is better to do this early in the operation, for once the peritoneal attachments are divided, it is far easier to bring the rectum down, and also to avoid injuring the ureters.
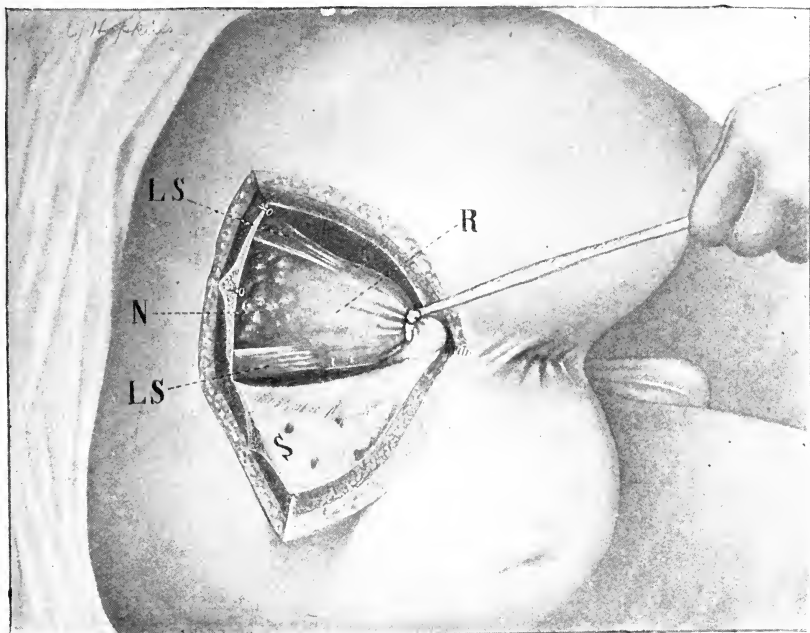
FIG. 343. Second step in bone-flap operation. R, rectum; N, neoplasm; LS, lateral rectal ligaments; S, sacrum. (Tuttle.)

The serous membrane is incised close to the rectum on the front and sides of the latter, but higher up and further back the mesorectum is severed close to the sacrum, so that the superior hæmorrhoidal vessels may be avoided and the lymphatic glands removed with the growth. The rectum and the presacral cellular tissues are carefully separated from the concavity of the sacrum to the desired extent, gentle traction being made on the bowel while this is being done. When the bowel at least three inches above the growth can be brought down to the healthy segment two inches below the disease, or better still to the anal margin, the peritoneal cavity is cleansed and closed with sutures, some of which are passed through the serous covering of the rectum well above the disease. A gauze pack may be used instead of sutures, which are difficult to insert, and packing is just as safe. After this important step has been taken the bowel at least three inches above the growth is divided between two clamps, and

the ends sterilised with the cautery.   The superior hæmorrhoidal artery is tied.   The growth and the lower portion of the rectum are then drawn downwards and separated by blunt dissection from the bladder and prostate or from the vagina.   This dissection is far simpler and safer when conducted from above downwards instead of in the reverse direction ; moreover, it is accompanied with much less hæmorrhage (Tuttle). A sound in the urethra and bladder in the male, and an assistant's finger in the vagina in the female, act as useful guides in difficult cases.   When the separation has been carried well below the growth, the bowel is clamped, and divided two inches below the disease.   All bleeding must
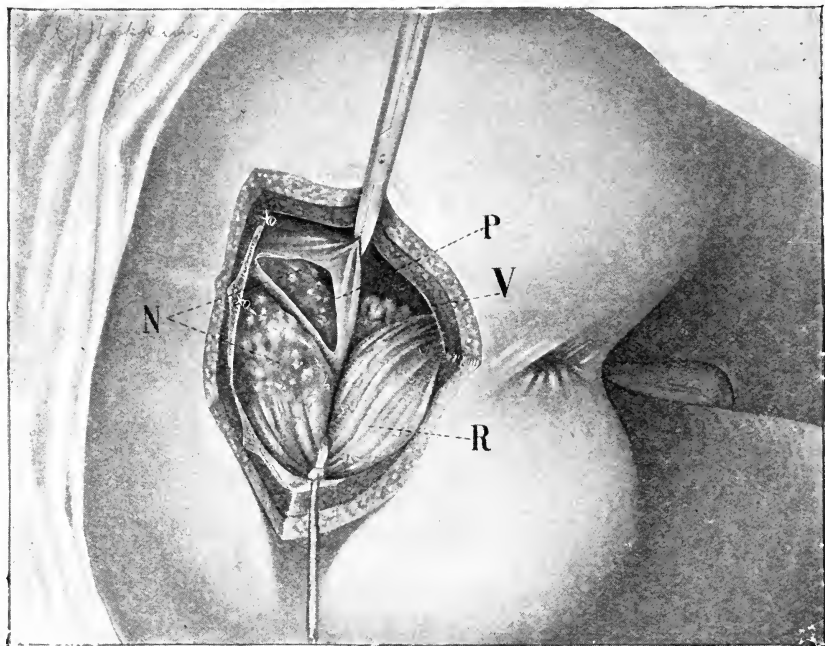
Fig. 344.   Third step in bone-flap operation.   P, opening in the peritoneum ; V, seminal vesicle and bladder ; N, neoplasm ; R, rectum.   (Tuttle.)

be arrested, vessels ligatured, and the wound cleansed with gauze wrung out of hot saline.

Treatment of the Ends of the Bowel.   The methods advocated by different surgeons as regards this most important step vary very considerably, and at the present time it cannot be said that the question is by any means settled.   Kraske,[1] after having abandoned it for some time, on account of repeated failures, has finally returned to his original plan of immediate direct suture, finding that complete or almost complete union can be obtained if the bowels are kept constipated for eight to ten days after the operation.   The anterior and lateral portions are united by two tiers of sutures, one passing through the whole thickness of the bowel, and the other through mucous membrane only. The posterior part is closed by inverting sutures not involving the mucous

[1] *Ann. Surg.*, vol. ii, 1897, p. 380.
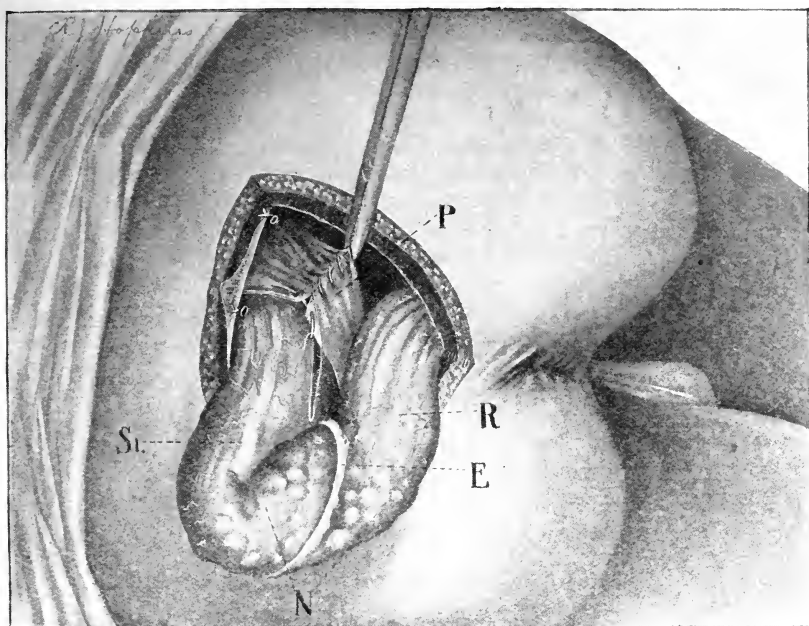
FIG. 345. Fourth step in bone-flap operation. R, rectum ; Si, sigmoid ; E, site of recto-vesical cul-de-sac : P, peritoneal cavity closed. (Tuttle.)
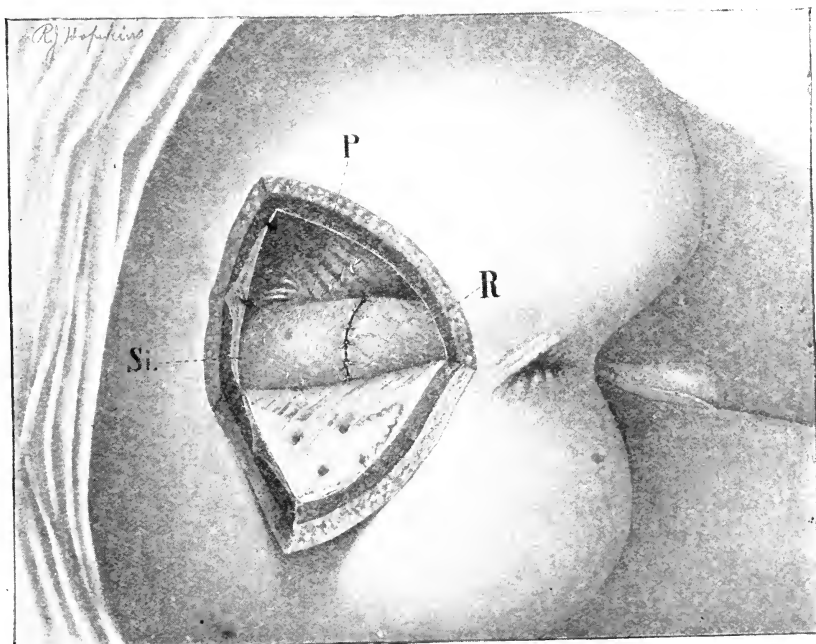
FIG. 346. Fifth step in bone-flap operation. The growth has been resected, and the ends of the intestine have been sutured together. (Tuttle.)

surface. A rubber tube is passed into the bowel above the suture line and sewn to the anus. This allows gas to escape and prevents over-distension of the bowel and strain upon the sutures. When the growth does not reach very low down this method may be carried out, but if the external sphincter has to be sacrificed, a sacral anus may be formed by fixing the upper divided end of the bowel to the posterior angle of the wound as recommended by Hochenegg.[1] When end-to-end union is attempted it is well to pass a few sutures through the mesorectum and the skin in the neighbourhood of the coccyx to lessen the tendency of the bowel to retract. Paul, who gives a series of twenty-eight cases with four deaths,[2] has abandoned approximation of the divided ends if more than three inches
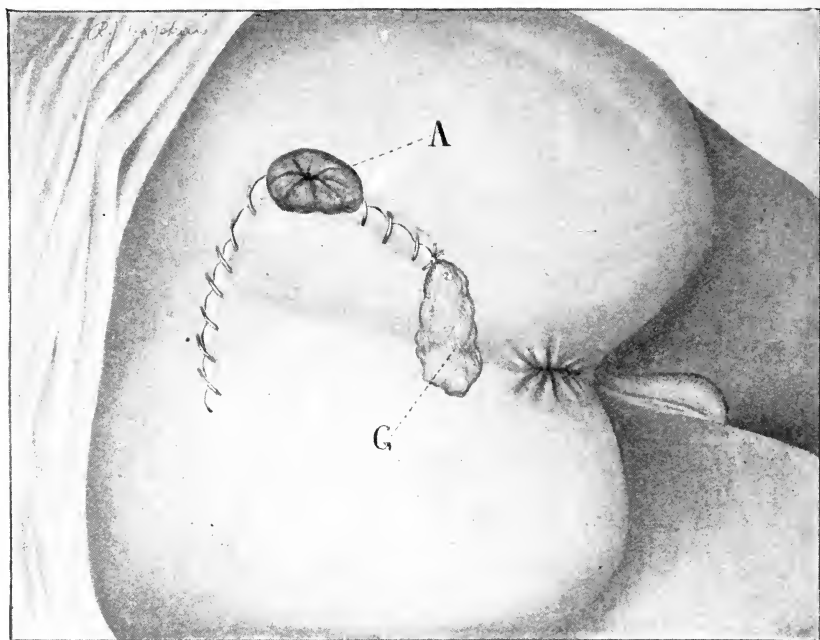
Fig. 347. Sacral anus. Made in bone-flap operation when it was impossible to establish aperture in normal position. (Tuttle.)

of the rectum have been removed, and uses one of his tubes. This method of inserting a tube has the advantages of being simple and rapidly used; it also prevents contamination of the wound with fæces, and further, any large vessels in the intestinal wall are closed with a single ligature. The tube becomes loose about the fourth day. The disadvantage of the tube is that its presence prevents the surgeon from fashioning a smaller artificial anus. But this is a minor point. However well the anus may look at the time, artificial support is almost certain to be required later on, when part of the sacrum and coccyx has been removed. Hence, to prevent prolapsus, and to aid in giving a patient control, such a truss-pad as that of Mr. Paul will be found a real boon.

Gersuny[3] advocates treating the upper end of the rectum, if long

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[1] *Brit. Med. Journ.*, 1900, vol. i, p. 1031.
[2] *Lancet*, 1897, vol. ii, p. 78.   [3] *Centr. f. Chir.*, 1893, No. 6.

enough, by torsion, and then fixation of the twisted gut to the skin by suture. The end is grasped by catch-forceps and twisted around its own long axis until considerable resistance is experienced on attempting to introduce the finger into the bowel. He has treated two cases in this way successfully. Mr. Ball [1] has also used it in one case, and recommends it. Dr. Gerster, of New York, has published two cases in which he adopted this plan successfully, and thinks that the method deserves preference and extensive trial.[2]

Witzel [3] reports [4] six successful cases in which the end of the rectum was treated as follows. A short incision having been made a little above the free margin of the gluteus maximus, this muscle is perforated with a
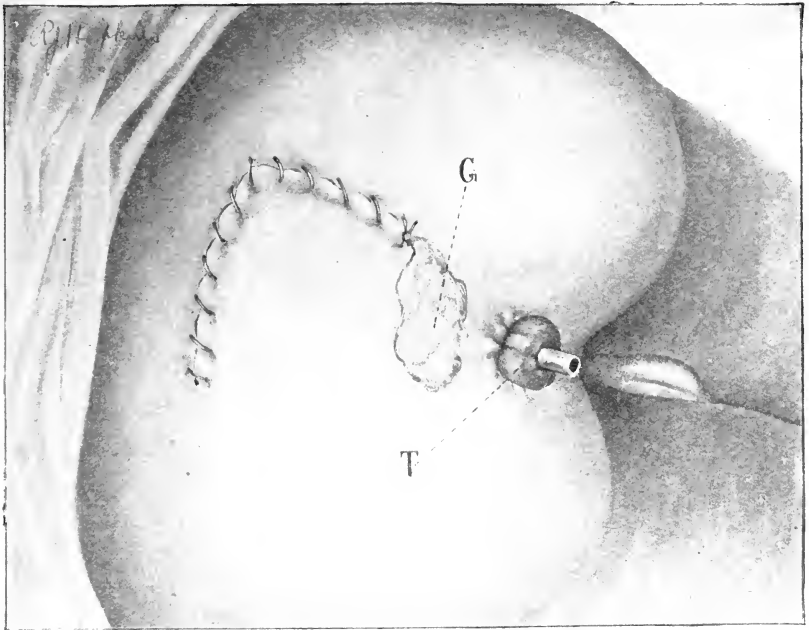
FIG. 348. Final step in bone-flap operation. G, gauze draining retro-rectal space; T, tampon and drainage-tube in anus. (Tuttle.)

blunt instrument, and the rectal stump drawn through, the edges of the gut being united to those of the skin.

Taylor also describes a successful case treated by the method of Moulonguet of Amiens. " He removes the mucous membrane of the lower segment down to the anus, taking good care not to injure the external sphincter. When the cancer has been excised he draws down the upper end and sutures it to the anal skin. Moulonguet remarks that with this method there is less chance of abscess and fistula, since the intestine opens on to the exterior." This method is to be strongly recommended, for the chances of infection of the deeper parts of the wound

[1] Loc. supra cit.
[2] Med. Record, February 10, 1894; Ann. of Surg., October 1895, p. 499.
[3] Willems and Rydygier had recommended a similar step before, from experiments on the dead body (Centr. f. Chir., 1893, No. 19; 1894, No. 45).
[4] Centr. f. Chir., 1894, No. 40.

and dangerous cellulitis are greatly diminished by it. This is nearly always practicable if free use be made of the loop of the pelvic colon. The bowel must be separated higher than is usually done, so that the pelvic loop opens out, after the superior hæmorrhoidal vessels are divided, and the hand has been passed up to mobilise the iliac colon. The divided end should bleed well when the clamp is released.

Keen [1] is in favour of total closure of the lower end of the colon and establishing a permanent abdominal anus. He performs a preliminary inguinal colostomy, and about a fortnight later removes the rectum, by Kraske's method. The lower end of the bowel is, however, closed entirely by means of sutures. The advantages claimed are that neither fæces nor mucus escape into the wound, so that primary union may be obtained; that, since there is no escape of fæces or mucus after recovery, the patient need not wear a napkin; and, thirdly, that prolapse is avoided.

(5) **The Abdomino-Perineal Operation.** Mr. Miles,[2] from a careful study of the spread and recurrence of carcinoma of the rectum, concluded " that the most complete and extensive perineal (including sacral) operation possible is with few exceptions quite inadequate for preventing recurrence of the disease." Up to the end of 1906 he had performed 59 perineal excisions with only one death, but 54 of these had recurrence. Therefore he decided to abandon all perineal methods of excision and designed the abdomino-perineal operation. I venture to quote his excellent description of the operation which appeared in the *British Journal of Surgery*, October 1914, p. 292. He has kindly allowed me to use some of his figures.

" **The Abdominal Portion of the Operation.** *Position of the Patient.* Involving, as it does, an extensive and deep pelvic dissection, the best position for the purpose is the high Trendelenberg. It is important, therefore, to select a good type of operating-table. Most hospitals nowadays are provided with these, but when operating at a nursing home or in a private house, the tables that are frequently used are incapable of giving the high position, and add immensely to the difficulties of the operation.

" *Incision.* The best incision is one extending from the symphysis pubis to the umbilicus, about a quarter of an inch to the left of the middle line. This can be extended beyond the umbilicus, if necessary, in fat subjects. The sheath of the left rectus muscle is then opened and the muscle drawn aside. The peritoneum is then divided throughout the length of the wound. This position of the incision is greatly to be preferred to the one in the left linea semilunaris, for two reasons : first, because it affords greater facilities for the pelvic dissection on the right side ; and second, because it permits of the incision for the colostomy being made at some distance from the main incision, so that the latter can be adequately protected from fæcal soiling during the subsequent progress of the case.

" *Exposure of the Pelvis.* A self-retaining abdominal retractor is now placed in position and the edges of the wound are widely retracted. Several patterns of these retractors are in use, but the one which I find most serviceable is that shown in Fig. 349. A rapid survey of the abdominal cavity is now made, with a view to ascertaining the possible presence of extramural spread. The pelvic mesocolon should be carefully examined

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[1] *Journ. Amer. Med. Assoc.*, 1898.
[2] *Brit. Med. Journ.*, 1910, vol. ii, p. 941.

for nodules or plaques of growth.   The most common positions in which these are to be found are (*a*) along the parietal border, in the course of the superior hæmorrhoidal and inferior mesenteric vessels ; (*b*) along the margin attached to the colon, where the paracolic lymph-glands exist ; and (*c*) in the substance of the mesentery itself, anywhere between these two lines.   If even quite minute nodules are discovered, this fact is direct evidence that widespread extramural extension of the disease

Fig. 349.   Crushing the pelvic colon at the seat of election.   The patient is in the Trendelenberg position.   The margins of the abdominal wound are widely retracted by a self-retaining claw retractor.   The pelvic colon is drawn through the wound and the distribution of the vessels in the mesocolon displayed.   A crushing clamp (author's pattern) is applied to the part of the bowel supplied by the loop of anastomosis between the first and second sigmoidal branches of the inferior mesenteric artery.

has taken place, and the case had better be deemed inoperable, because recurrence is almost certain to ensue higher up in the median chain of the lumbar glands, or in the small intestine, as a result of contact.   The failure to find evidence of visible spread in these situations does not necessarily mean that there is an absence of extramural extension, because such spread may exist in a microscopical state, though even in such a contingency a wide removal of the mesocolon may succeed in circum-

venting it; whereas, if visible spread exists, the widest possible removal may not get beyond the area of upward microscopical extension.

" At this stage opportunity may be taken to ascertain the condition of the liver. In my experience, however, there is not much to be gained from this. If there is recognisable disease in the liver, there is nearly always obvious extramural disease in the pelvis or in the peritoneum, and if the latter is still in the microscopical stage, then any existing disease in the liver is too small to be recognised, except by post-mortem examination.

" Lastly, the attachments of the diseased part of the bowel should be inquired into. If the growth is situated upon the anterior wall of the bowel, especial attention should be paid to possible involvement of the bladder in the male or the posterior wall of the vagina in the female. In either of these circumstances the case is, in my opinion, inoperable. If the bladder is involved it is not possible to remove the growth completely, and if the vagina is implicated the additional operation of removal of the uterus and posterior wall of the vagina entails too severe a strain upon the patient's endurance. I have done this on three occasions, and all the patients succumbed.

" The question of operability having thus been definitely decided, the operation itself is then proceeded with. It should be constantly borne in mind that one of the chief factors in its ultimate success is the rapidity with which the various stages of the procedure are carried out. A definite system of working should be adopted, and each step should be completed in sequence It is of the greatest importance to clear the pelvic cavity of small intestine. In nearly all cases there is pronounced enteroptosis, the majority of the patients being at or beyond middle life. If the patient is taking the anæsthetic comfortably, the small intestine usually drops out of sight into the upper abdomen; but in a great many instances this does not happen, and the operator is constantly embarrassed by loops of small intestine being forced down into the pelvis during respiratory movements. Under these circumstances I do not hesitate to pull all the available small intestine out through the wound and allow it to hang down outside the abdomen, after having been covered by a Cripps abdominal swab which has been wrung out of warm saline solution. In Fig. 349 the coils of small intestine can be seen beneath such a swab. From time to time during the abdominal part of the operation the swab is changed. I have done this on a great many occasions, and I can confidently say that I have never seen any harm result therefrom, either from the intestine losing temperature or from its becoming temporarily congested on account of its dependent position.

" **The Pelvic Operation.** *First Stage.* The pelvic colon is drawn through the wound and the position of its vessels noted. Occasionally there is some difficulty in doing this, owing to peritoneal bands of adhesion. These adhesions are not of inflammatory origin, but are due to altered peritoneal attachments consequent upon coloptosis. When such adhesions are found, they should be freely divided on the outer side of the pelvic mesocolon so as to mobilise the pelvic colon, and thus permit of its proximal portion being subsequently utilised in the formation of the colostomy without undue tension. A point in the bowel is then selected between the anastomotic loops of the first and second sigmoidal branches of the inferior mesenteric artery. To this point an intestinal crushing clamp is applied (Fig. 349) and left on for a couple of minutes. In very

stout subjects it may be difficult to observe the exact distribution of the blood-vessels in the mesocolon. Under such circumstances the safer plan is to place the clamp somewhat nearer the middle of the loop than otherwise.

"*Second Stage.* The clamp is now removed, the crushed area of the bowel corresponding in width to that of the blade of the clamp. The clamp I use has a blade one inch wide, which affords ample room for dividing the crushed part of the bowel after the two ligatures have been applied. A stout ligature is then passed through the mesocolon at either extremity of the crushed area and tied tightly, thus firmly occluding the lumen of the gut in two places. The crushed portion of the bowel is now divided with scissors, the cut extending into the crushed portion of the mesocolon. The ligatured ends of the bowel are then invaginated by means of a purse-string suture, the attachment of the mesocolon to the bowel having been first divided for a short distance, close to and parallel
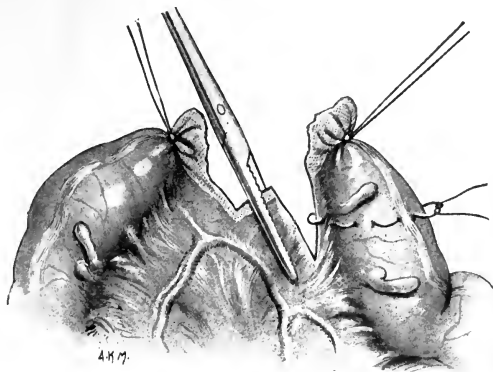
Fig. 350. Treatment of the divided ends of the bowel. A hæmostatic clamp is placed on the mesocolon, and an incision is made with scissors close to and parallel to the bowel for the distance of an inch. A purse-string suture is made to encircle the isolated extremity of the bowel, and the closed end is invaginated.

with the bowel (Fig. 350), in order to render the invagination more easy. The distal end of the bowel must be carefully closed, to prevent the possible escape of its contents during the manipulation of this portion of the intestine in the subsequent steps of the operation.

"*Third Stage.* An incision is now made through the peritoneum on the outer aspect of the pelvic mesocolon, at the level of the left sacro-iliac synchrondrosis, along its parietal border. Through this incision the left ureter is defined as it crosses the left common iliac artery (Fig. 351). In this position the left ureter is parallel to and in close contact with the inferior mesenteric vessels, and unless it is clearly defined and drawn aside may easily be included in the ligature when the latter is applied to the vessels in this situation. The left ureter having been held aside by an assistant, a ligature is then applied to the inferior mesenteric artery at a point immediately below the origin of the first sigmoid branch (Fig. 351). In some instances the second sigmoid artery arises from a common trunk with the first, in which case the ligature must be placed below the common trunk, and the second sigmoid artery will have to be ligatured separately when the mesentery is divided. When the inferior

mesenteric vessels have been thus ligatured, the remainder of the pelvic mesocolon is divided, the inferior mesenteric vessels, as they lie in its parietal border, being also divided below the point of ligature. All
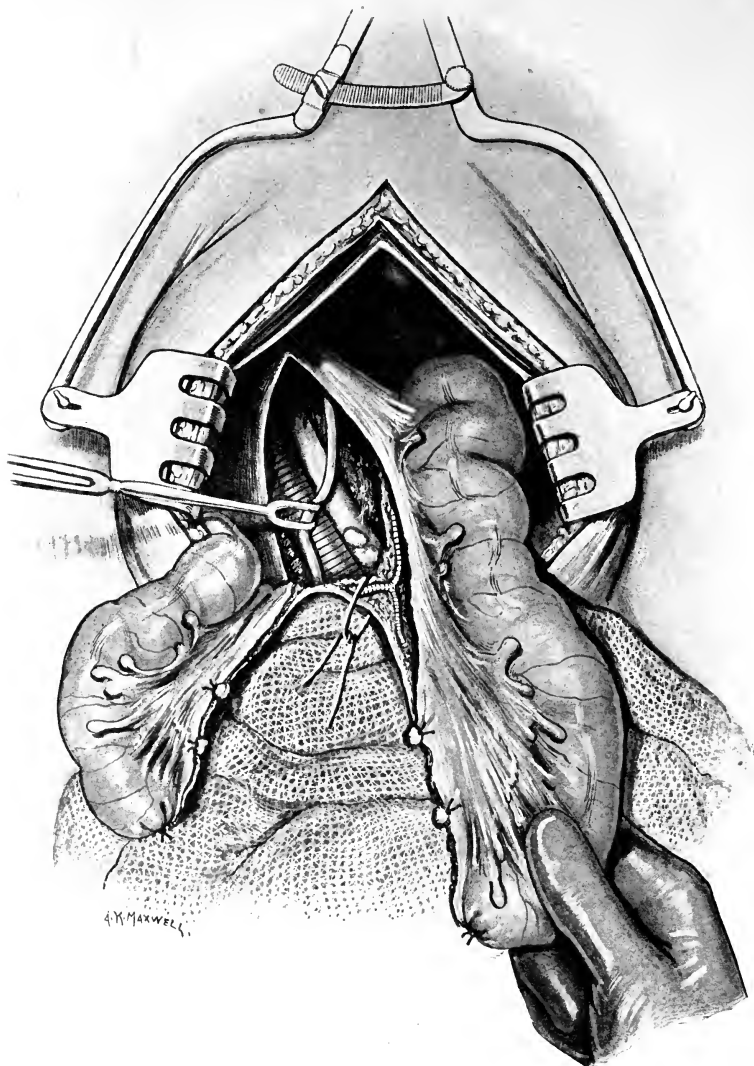
Fig. 351. Showing complete division of the pelvic mesocolon and ligature of the inferior mesenteric artery at the seat of election. The portion of the bowel on the left-hand side is that from which the colostomy is eventually made. The incision in the peritoneum, carried forward on the left side, exposes the left ureter as it crosses the left common iliac vessels. The ureter is drawn aside while the ligature is placed around the inferior mesenteric vessels.

bleeding vessels in the proximal portion of the pelvic mesocolon having been ligatured, the proximal end of the colon is temporarily dropped into the abdominal cavity out of the way.

" *Fourth Stage.* Commencing at the point where the pelvic meso-

colon has been cut across, an incision is made through the peritoneum on either side of the attachment of the lower portion of the pelvic mesocolon, at a distance of about one inch from it.   These incisions are carried down into the pelvis, parallel to the mesocolon, to the level of the peritoneal reflection.   The reason for making these incisions quite an inch away from the attachment of the mesocolon is because the lymphatic vessels which accompany the superior hæmorrhoidal vessels extend a little way
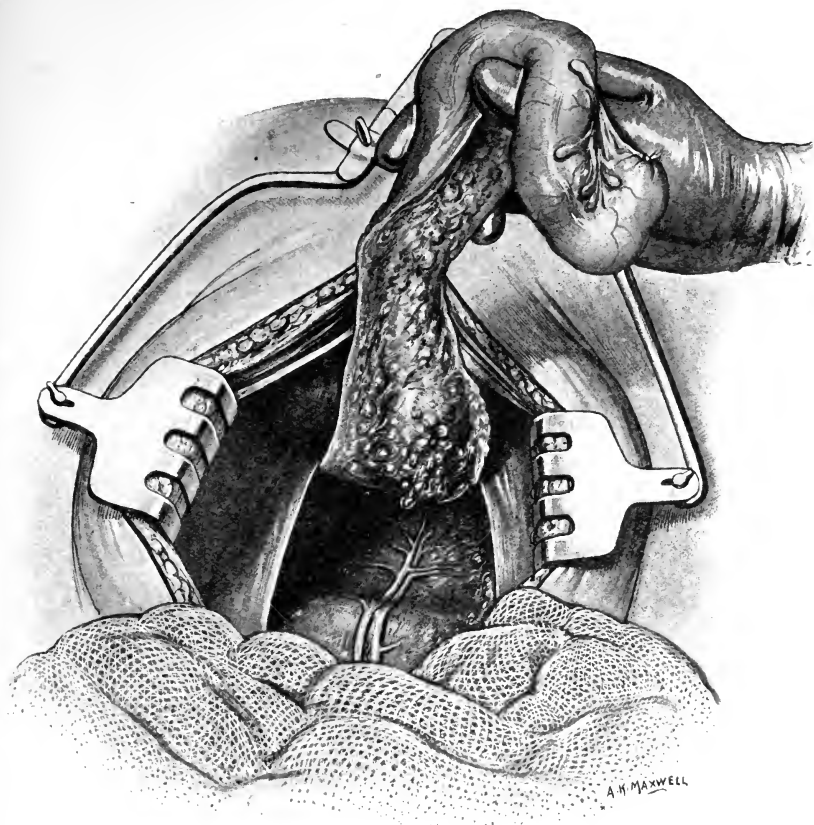
Fig. 352.   Showing the rectum and the retrorectal tissues separated from the hollow of the sacrum as far as the sacrococcygeal articulation.   After ligature of the inferior mesenteric vessels, the remains of the pelvic mesocolon are divided below the ligature, and the incisions in the pelvic peritoneum are carried forwards on either side along the lateral wall of the pelvis.   The cellular space in front of the sacrum is opened up as far as the coccyx.

beneath the peritoneum on either side, and on several occasions I have seen plaques of growth to one or other side of the line of attachment of the mesocolon.   When these incisions have been made, the distal portion of the pelvic colon is drawn forward by an assistant, and the connective-tissue space in front of the concavity of the sacrum is opened up.   By inserting the fingers of the left hand into this space, the lower part of the pelvic mesocolon with the contained blood-vessels and lymphatic glands,

and the rectum ensheathed in the fascia propria recti, are readily detached from the ligamentous structures in front of the sacrum (Fig. 352). In doing this, care should be taken not to wound the median sacral veins, which course down the anterior surface of the sacrum in the middle line. The separation of the rectum from the hollow of the sacrum should be carried down to the level of the sacro-coccygeal articulation, a point which can be readily recognised by the fact that the fascia propria recti is firmly adherent to the last piece of the sacrum and resists being stripped from it.

" *Fifth Stage.* The preceding incisions in the peritoneum are now carried forwards on either side of the pelvis to meet anteriorly behind the base of the bladder in the male or the upper portion of the vagina in the female. In making these incisions special care should be taken to avoid injuring the ureters which are adherent to the parietal peritoneum, as they skirt the lateral wall of the pelvis on their way to the bladder. The separation of the anterior wall of the rectum is now proceeded with by means of blunt dissection. In the male it must be separated from the bladder and from the vesiculæ seminales as far as the upper border of the prostate When doing this, the vesiculæ seminales and the vasa deferentia are liable to be injured, and therefore great care should be taken to avoid them. Unless the separation is carried down to the prostate, much difficulty will be experienced in this situation during the perineal portion of the operation. In the female the separation from the vagina is easily effected, and need only be carried half-way down the posterior wall.

" *Sixth Stage.* The isolation of the rectum from its lateral attachments is now proceeded with, first on the left side and then on the right. When working on the left side the left ureter should never be lost sight of, as it lies close to the left side of the rectum and may easily be injured. On the right side the ureter is some distance away, and should be left undisturbed in its attachment to the parietal peritoneum. This part of the isolation of the rectum is much the most difficult, on account of the presence of the lateral ligaments of the rectum. These are well-developed vertical bands of dense connective tissue, having their origin in the recto-vesical fascia and extending from the lateral aspects of the rectum obliquely forwards and outwards towards the base of the bladder (Fig. 353). Each band is from one and a half to two inches in depth and very strong. Unless they are completely divided on both sides as far as the levatores ani, much difficulty will be experienced in withdrawing the rectum through the perineal wound. I am quite sure that it is the failure completely to divide these lateral ligaments during the abdominal part of the operation that renders the perineal portion an unnecessarily tedious and prolonged procedure. During the division of the left lateral ligament the left ureter should be carefully protected from injury. In the substance of these ligaments the middle hæmorrhoidal artery is contained, and must, of course, be divided. As a rule this artery is quite small, and seldom requires a ligature. Occasionally I have seen free bleeding from it, but this is easily controlled. As this is the only artery arising from the branches of the internal iliac which is divided during the abdominal part of the operation, I do not understand why many textbooks advise ligature of the internal iliacs as a preliminary measure in abdominal extirpation of the rectum.

" *Seventh Stage.* The rectum having thus been thoroughly freed in

all directions—anteriorly, as far as the upper border of the prostate or half-way down the posterior vaginal wall, as the case may be; posteriorly, as far as the level of the sacro-coccygeal articulation; and laterally, down to the levatores ani—the whole of the isolated portion of the bowel is
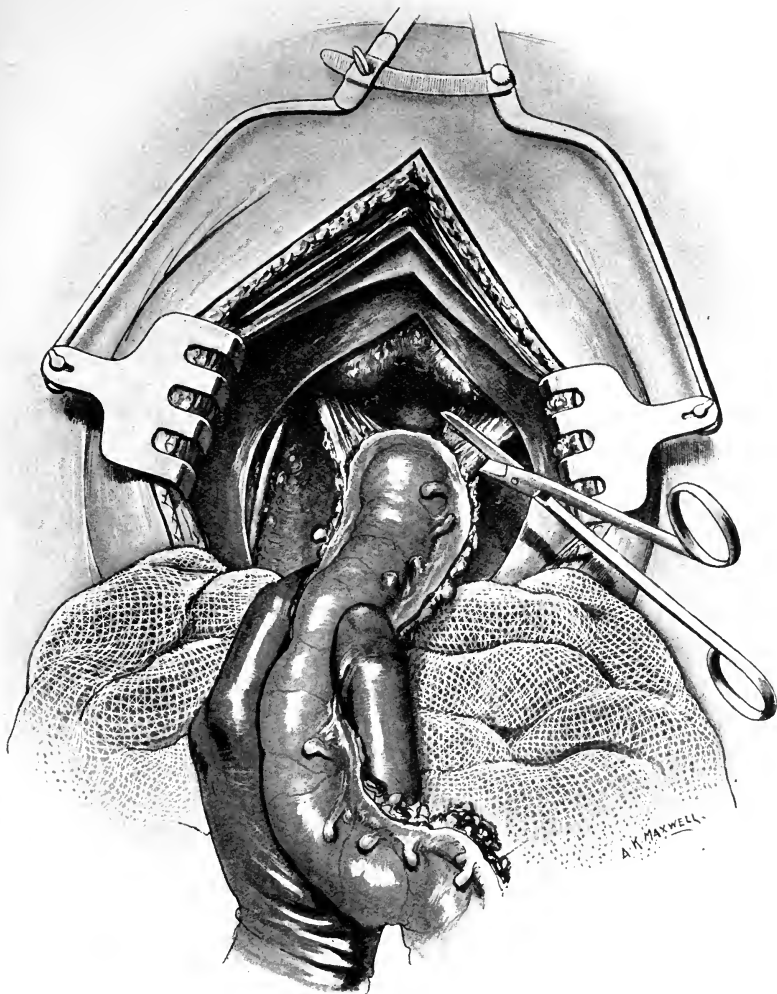
Fig. 353. Showing the separation of the anterior connections of the rectum as far as the upper border of the prostate, and division of the lateral ligaments. The lateral incisions in the peritoneum have been extended on either side so as to meet in front behind the base of the bladder. The lateral ligaments have been defined as far as the upper surface of the levator ani on either side. These ligaments are then completely divided with scissors, the ureter on the left side having been drawn aside.

crowded down into the cavity of the pelvis and preparations made for re-establishing the floor of the pelvis by peritoneum. Owing to the free removal of peritoneum on either side of the pelvic mesocolon and of the

peritoneal covering of the floor of the pelvis, a large gap remains.   On no account should the pelvic mesocolon be left *in situ* with a view of facilitating the closure of this gap, because this is directly in the line of the upward spread, and is therefore to be considered highly dangerous tissue.   I cannot emphasise too strongly the necessity for completely removing this structure in every case, together with a wide strip of the adjacent peritoneum, if immunity from recurrence is to be hoped for.

" First of all, the peritoneum from the lateral walls of the pelvis should be freely dissected up, care being taken to avoid injury to the ureters during the process.   When this has been done, it will generally be found that the posterior margins can be brought together in front of the promontory of the sacrum without undue tension, and sutured to the stump of the pelvic mesocolon at the point where the inferior mesenteric vessels have been tied.   This being completed, a large pear-shaped gap still remains to be closed, the lateral margins of which cannot possibly be approximated.   This gap may be readily closed as follows : (*a*) In the male, by dissecting up a flap of peritoneum from the bladder and stretching it backwards across the gap and suturing it there (Fig. 354) ; (*b*) in the female, either by making use of the uterus to fill up the gap—a method which I employed in my earlier cases but have since given up owing to menstrual troubles having resulted in some instances—or by dissecting up the innermost layers of the broad ligaments and utilising them to fill up the space.   The latter method is the one I always employ now, with the happiest results.

" In those instances in which the peritoneum is very delicate great care should be taken to reinforce the suture line in those places in which there is tension and a possibility of the stitch-punctures tearing.   In one of my cases a knuckle of small intestine became herniated through a small hole thus made, and the patient developed intestinal obstruction, from which he succumbed.   When the peritoneum is very delicate the suture-line may be advantageously strengthened by means of an omental graft.

" *Eighth Stage.*   The proximal end of the pelvic colon is now utilised for establishing a colostomy.   The best position for this is at a point situated one and a half inches internally to the left anterior-superior spine of the ilium, along a line extending from that bony prominence to the umbilicus.   A short incision, one and a half inches long, is made, the centre of which intersects the above-mentioned line at right angles.   This incision extends through the skin and subcutaneous tissues only.   The aponeurosis of the external oblique muscle is now divided to the extent of one inch, and then the muscular fibres of the internal oblique and transversalis muscles are separated in the direction of their fibres by blunt dissection.   An opening just large enough to admit the index finger is then made through the transversalis fascia and the peritoneum.   Through this small opening the stump of the proximal end of the pelvic colon is drawn, and fixed in position at the upper and lower angles of the wound by means of silkworm gut.   I do not think there is any advantage in bringing the bowel out through the fibres of the left rectus muscle, as is sometimes advocated in the performance of colostomy.   The chief point to be borne in mind is to make the opening just large enough to allow the stump of the bowel to be drawn through it and no larger, lest herniation in the vicinity of the colostomy should occur.

" *Ninth Stage.* The toilet of the peritoneum is now made, preparatory to closing the abdominal wound. I always introduce from two to three pints of warm (110°) saline solution into the peritoneal cavity before closing the abdomen. This warms up the intestine, diminishes shock, allays subsequent thirst, and tends to prevent adhesions. The abdominal wall having been sutured in three layers, a temporary dressing and bandage are applied, the Trendelenberg position is dispensed with, and the
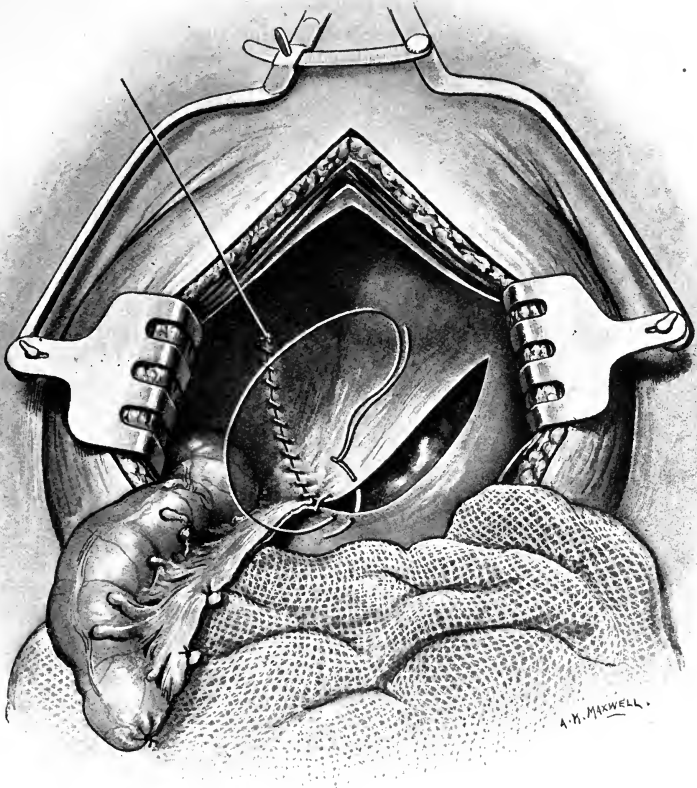
FIG. 354. Showing method of restoring the pelvic floor of the male. A flap of peritoneum has been dissected up from the bladder and drawn backwards until it meets the cut edge of the pelvic mesocolon, to which it is sutured. On the right side the distal portion of the pelvic colon can be seen lying in the pelvic cavity below the new pelvic floor.

patient is turned into the right dorsal and semiprone position in order that the perineal portion of the operation may be proceeded with.

" **The Perineal Portion of the Operation.** *Incision.* The anus having been closed by means of a purse-string suture, a transverse incision about four inches in length is made at the level of the sacro-coccygeal articulation. From the centre of this a longitudinal cut is made in the internatal furrow, and carried down to a point one inch from the posterior

margin of the anus. From the inferior extremity of this, incisions are carried to the right and to the left of the anus in the shape of a horse-shoe, and the anterior extremities of these are joined by a transverse cut. It is important that the arms of the horseshoe should embrace as wide an area of peri-anal skin as possible, because the skin in this region is especially prone to develop recurrent growth. The gluteal skin-flaps are then reflected and retracted out of the way, thus laying bare the coccyx,

" *Removal of the Coccyx.* The sacrococcygeal joint is opened and the coccyx dissected out ; the incisions surrounding the anus are then deepened so as to include the whole of the ischiorectal fat (Fig. 355). It is never necessary to remove a piece of the sacrum, as ample room is provided by removal of the coccyx alone. In fact, sufficient room for the completion of the operation can be obtained without even removing the
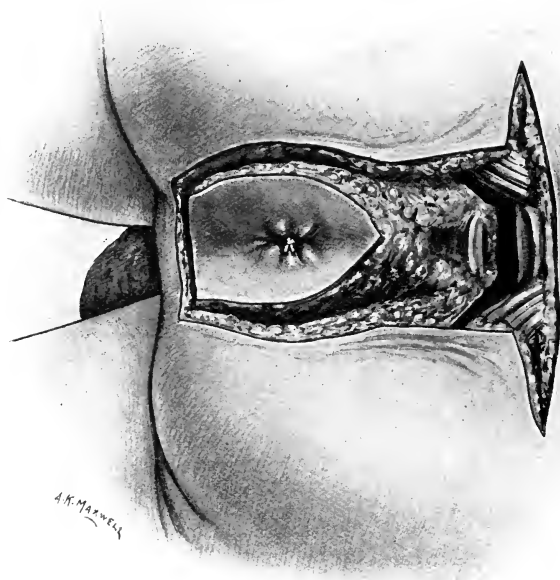
Fig. 355.   Showing the reflection of the skin-flaps and opening of the sacro-coccygeal joint. When the surface incisions around the anus are deepened, as much as possible of the ischiorectal fat is included.

coccyx ; but I think it is best to remove it, because as the coccygei muscles must be removed, the bone would be left without any lateral attachments.

" *Exposure of the Pre-Sacral Cavity containing the Isolated Bowel.* A small transverse incision is made into the dense connective tissue immediately below the sacrum, where the attachment of the fascia propria recti can readily be detached from the ventral aspect of the lowermost piece of the sacrum. The index finger is then thrust into this, when, supposing that the separation of the rectum from the front of the sacrum has been carried down to the level advocated above, it readily passes into the space containing the isolated bowel. A transverse incision is then made through the coccygei muscles on either side, extending out-wards as far as the great sacrosciatic ligaments. Through the ample

opening thus made the isolated bowel is drawn down to its full extent (Fig. 356). When the separation of the anterior connections of the rectum have been carried down to the prostate during the abdominal part of the operation, the base of the bladder and the vesiculæ seminales, with the vasa deferentia and the upper part of the prostate, come into view. In the female, the uterus and the upper half of the posterior vaginal wall can be plainly seen.

" *Division of the Levatores Ani Muscles and Severance of the remaining Connections of the Rectum.* By making traction upon the bowel with the left hand the levatores ani are put upon the stretch. If they do not come into view, it is because the lateral ligaments of the rectum have not been
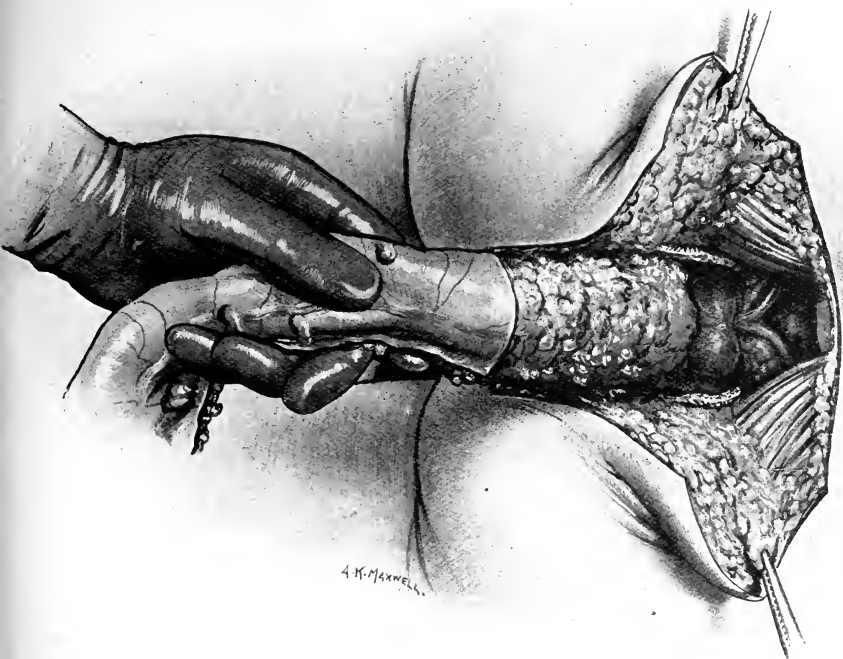
Fig. 356. Showing the pelvic colon and the isolated upper part of the rectum withdrawn from the cavity of the pelvis. If the isolation of the rectum has been efficiently carried out anteriorly, posteriorly, and laterally, the bowel can be readily withdrawn, in the manner shown, and the base of the bladder, the vesiculæ seminales, with the vasa deferentia and the prostate gland, are clearly exposed to view. The levatores ani are then divided close to their origin from the pelvic wall.

completely divided from above. In that case considerable difficulty may be experienced in delivering the loosened bowel through the perineal wound, and until the lateral ligaments are completely severed the levatores cannot be divided. The levatores are now divided at their origin from the lateral wall of the pelvis, the puboprostatic fibres being detached from the prostate. In those instances in which the growth is situated on the anterior wall of the ampulla of the rectum, I always make a practice of dissecting away the prostatic capsule as well.

" All that now remains to be done is to dissect away the anterior wall of the anal canal from the tissues forming the central point of the perineum, great care being taken not to wound the membranous portion of the urethra in so doing.

" *Completion of the Operation.* After the removal of the rectum and isolated portion of the pelvic colon, usually about sixteen inches in length, a huge cavity is left. This cavity is surrounded by bony structures behind and at the sides, and it is absurd to suppose that it can be sewn up so as to obtain healing by primary intention. The cavity must heal gradually by granulation, portions only of the skin incision being brought together by sutures. I always pack the cavity with long strips of gauze, so as to afford support to the new pelvic floor formed only by peritoneum. It is not advisable to allow the gauze to be in direct contact with the walls of the cavity, because it becomes firmly adherent to them and gives considerable trouble and pain to the patient when it is removed. In one of my earlier cases the peritoneum of the pelvic floor was torn when the gauze was removed, and a coil of small intestine became herniated through the opening. I always use a sheet of green protective, two feet square, for lining the cavity, and then pack the gauze into it, the subsequent removal of the gauze thus being rendered easy and painless. Dressings and bandages are then adjusted, and the patient is turned upon his back so that the abdominal wounds may also be dressed. Before the patient leaves the table the ligatures closing the stump of the proximal end of the pelvic colon are removed, and the open end of the bowel is covered with green protective and a pad of gauze."

Mr. Miles [1] brought his results up to date.

He had performed the operation in 42 cases with a death-rate of 40 per cent. All the 8 cases over 60 years of age died, whereas only 9 out of 34 patients below that died, giving a mortality of 26 per cent. Of the 25 who survived the operation 4 had recurrence. Of the remaining 21, 2 had died of other causes and 19 were alive without sign of recurrence—6 over three years, 4 over two years.

" *Remarks.* The mere combination of the abdominal and the perineal routes in the extirpation of the cancerous rectum is not necessarily a radical procedure. The object of the combined operation is not so much to facilitate operative manœuvres as to safeguard the patient against the onset of recurrence. Such a desirable end can only be attained by a thorough eradication of all the tissues comprising the three distinct zones of spread. This is the only conclusion that can be arrived at from a correct interpretation of the facts in regard to the localities in which post-operative recurrence manifested itself. In the surgical treatment of cancer of the rectum there seems to be among surgeons a decided prejudice against two things—(1) The establishment of an abdominal anus, and (2) the loss of the natural sphincteric control—and consequently from time to time one sees reported in surgical literature cases in which an operation for cancer of the rectum has been carried out to the exclusion of one or the other or both of these. Some of these operative procedures are most ingenious in their inception and are very skilfully executed, but one hears little of the after-results. It seems to me that if the proximal end of the pelvic colon is left long enough to be brought down to the anus, the greater part of the zone of upward spread is left behind, and consequently there would be greater liability to recurrence than if the whole of the pelvic colon

[1] *Brit. Med. Journ.*, 1911, vol. ii, p. 1597.

together with its mesocolon and adjacent parietal peritoneum were removed. However, there is room for much investigation on this point, and very valuable information would be obtained if the subsequent histories, extending over a period of at least three years, of patients who had undergone these less radical operations were published.

"The radical abdomino-perineal operation carried out on the lines here advocated is one of the most formidable operations in surgery. In its execution, speed in operating is of prime importance. Generally speaking, the operation can be completed in an hour and a half, but it should be borne in mind that every minute that can be saved is of great importance to the patient. In my series of twenty-six operations, the longest time was one hour and fifty-five minutes, and the shortest one hour and seven minutes."

(6) **Abdomino-Anal Excision**. The patient is very carefully prepared for about a week before the operation. Morphia gr. $\frac{1}{4}$ and atropine gr. $\frac{1}{100}$ are injected subcutaneously an hour before the operation. As soon as the patient is under the anæsthetic axillary infusion is commenced, generally a pint and a half being run into each axilla during the operation. This is very valuable in maintaining an equable blood pressure and thus preventing the development of shock. The surgeon stands on the left of the patient and makes a vertical incision through the lower and inner third of the left rectus. At first, the peritoneal opening is made only large enough to admit the left hand, which is passed up to the liver. The upper surface of each lobe is carefully examined for growth. As the hand returns the aortic and left iliac glands are felt. If these parts are healthy the hand is passed into the pelvis to examine the connections and mobility of the primary growth. If the growth is removable the incision is enlarged so that it reaches from the pubes to a little above the navel. The high Trendelenberg position is adopted, and the small intestines and the cæcum are displaced upwards and kept out of the way by means of a very large moist pad, supplemented by a gauze roll if any of the intestine tends to come down at the side.

Now it becomes evident which operation is the most suitable—the abdominal, the abdomino-perineal or the abdomino-anal. The pelvic colon is drawn up and held by an assistant while the peritoneum reflected from it to the left is divided vertically at least one inch from the bowel. Two fingers are inserted to lift the parietal peritoneum forwards from the blood-vessels and the incision is rapidly enlarged upwards. By gauze dissection the colon is mobilised nearly as high as the spleen, the spermatic vessels and the ureter being displaced backwards. The incision in the peritoneum to the left of the bowel is carried downwards to the floor of the pelvis and across the latter behind the bladder or vagina and up on the right of the bowel as far as the fourth lumbar vertebra. The pelvic colon and rectum are then rapidly mobilised, by gauze dissection, all the soft tissues and glands in front of the left iliac vessels and the sacrum being pushed forwards, and the left ureter being carefully preserved. The right ureter need not be seen. The separation is carried as far down as the tip of the coccyx. Then the bowel is separated from the structures in front of it—the vagina in the female, the bladder and prostate in the male. There is, as a rule, very little bleeding during this step, but occasionally the middle hæmorrhoidal vessels may have to be crushed or tied. The inferior mesenteric vessels are carefully examined and tied a little above the origin of the lower sigmoid artery (see Fig. 357). A ligature is tied

around the bowel at the point which is considered most suitable for joining to the anus. This must be at least four inches above the growth, and it is often a mechanical advantage to select a higher and more movable point. The bowel must have a good blood-supply down to the point selected. The ends of the ligature are left long. If the bowel that can be saved appears too short to come down to the anus without tension, it can generally be lengthened by (a) carefully dividing the peritoneum and connective tissues, but not the blood-vessels of the pelvic mesocolon, or (b) by further mobilisation of the descending colon even as far as the splenic flexure. If these steps are not effective a permanent colostomy must be adopted as in Miles's operation. The freely movable bowel is now pushed down into the pelvis and a roll of gauze is placed above it to collect any blood oozing
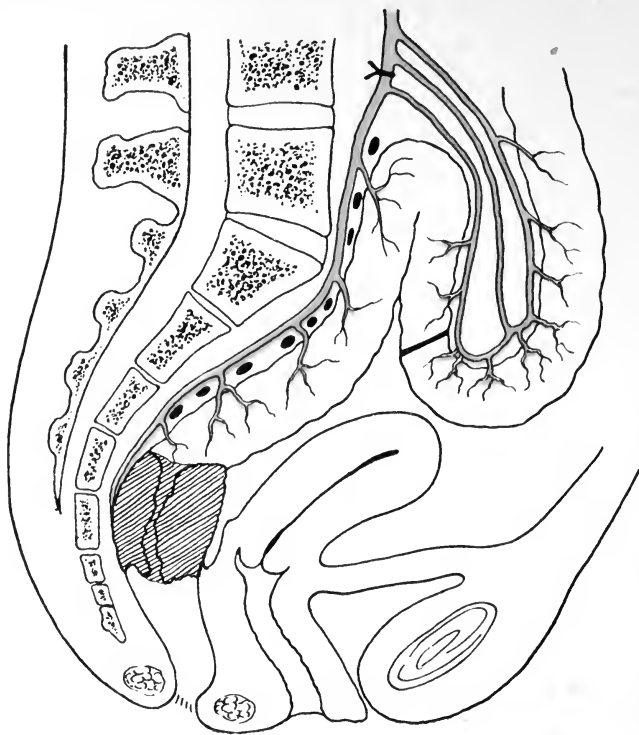
Fig. 357. Abdomino-anal resection. The ligature is in the superior hæmor-rhoidal artery, above the communication of the sigmoid arteries with it.

into the pelvis. No attempt is made to reconstitute the peritoneal floor of the pelvis, as this step hinders drainage and thus seems to be harmful rather than beneficial. Moreover, it is tedious and unnecessary.

The Trendelenberg position is abandoned, the gauze packs are removed, and the abdomen is rapidly closed in layers in the usual way. Then the patient is placed in the exaggerated perineal position with a firm flat pillow under the lower part of the sacrum. An incision is made around the anal margin and the anal mucous membrane is dissected up and firmly tied with stout silk. The hinder end of the incision is then carried backwards in the middle line as far as the tip of the coccyx and, if

necessary, prolonged by the left side of the latter. The fibres of the external sphincter and the deep muscles of the pelvic floor are rapidly separated, and the loose connective tissues behind the rectum are opened, and two fingers of the left hand are introduced into the pelvis to hook down the loose coils of bowel lying there. Gentle traction is made upon this while the lower end of the rectum is separated from its bed, care being taken not to damage the muscles of the pelvic floor and not to divide the anterior commissure of the external sphincter. Now a great length of unopened bowel including the growth hangs out of the wound. The ligature indicating the point selected for resection is identified, and
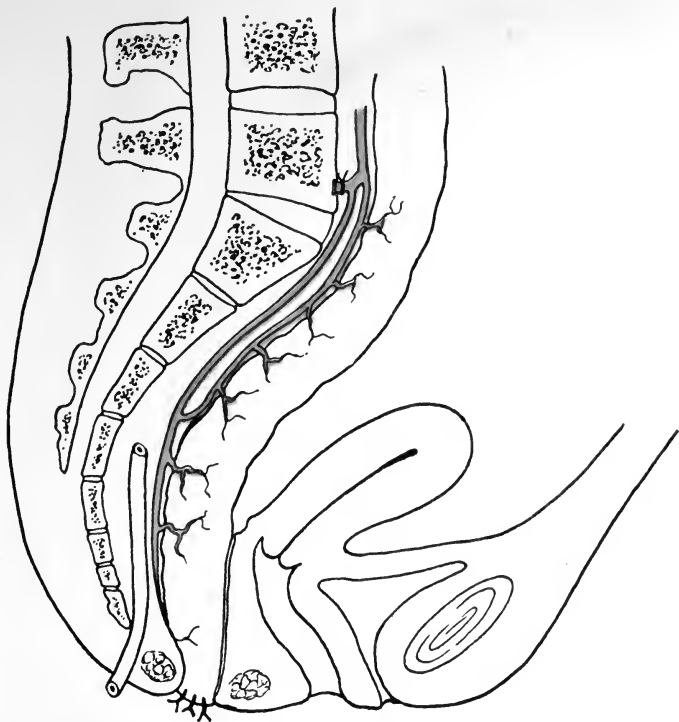
FIG. 358. Abdomino-anal resection. The pelvic colon has been brought to the anus.

should reach the anus without tension. The gauze roll is removed and the pelvis is dried. The assistant holds the bowel forwards in contact with the anterior commissure of the sphincter as the surgeon fixes it to the levatores ani and sphincter by means of several cat-gut sutures, picking up the appendices epiploicæ and the longitudinal muscular bands. Then the muscles are brought together behind the bowel and sewn with interrupted catgut sutures. Then three or four strong salmon-gut sutures are passed with long curved needles through the skin and structures of the pelvic floor, closing the wound behind the bowel except at its posterior extremity, where a soft split rubber tube, reaching into the hollow of the sacrum, is sutured to the skin (see Fig. 358). Then the bowel projecting at the anus is divided between two clamps and sewn to the skin by a contin-

uous silk suture. When the clamp is slightly loosened the cut end of the bowel should bleed freely and there should be no tension upon the bowel. As a rule the part removed is about ten inches long and includes all the primary lymphatic glands in the pelvic mesocolon. The operation lasts from fifty minutes to an hour and a half, taking longer in men than in women. After the operation the infusion is continued so that about five or six pints are given during the operation and the following twelve hours.
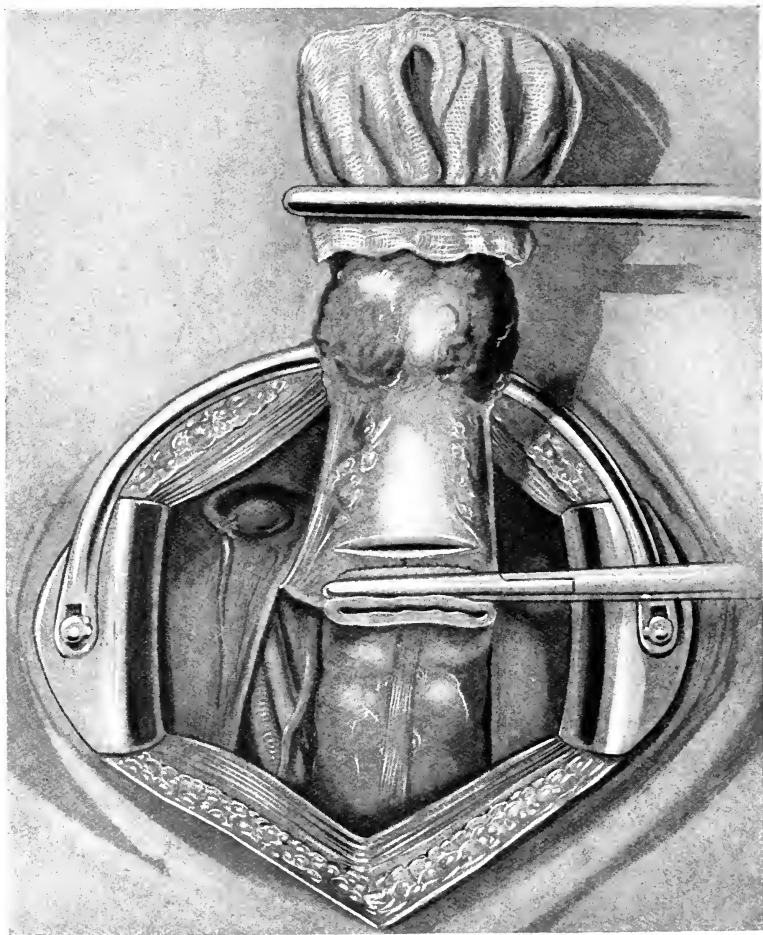
Fig. 359. Abdominal excision of a growth of the lower part of the pelvic colon. The part to be removed is used as a tractor to aid the anastomosis. The posterior part of the superficial suture has been inserted. Then the piercing suture is inserted as the rectum is gradually divided.

(7) **Abdominal Resection** is suitable for growths of the lower part of the pelvic colon at or near the recto-colic junction, but the anastomosis is difficult and dangerous. Balfour [1] described the following excellent method, which has been in use at the Mayo Clinic for several years.

[1] *Ann. of Surg.*, February 1910.

" (1) The patient is placed in a high Trendelenberg position and a long median incision is made between umbilicus and pubes.

" (2) The intestines are carefully packed off above, leaving only the lower sigmoid exposed in the pelvis.

" (3) Liberation of the affected portion of the bowel is effected by lateral incisions through the peritoneum, especially through the outer leaf of the sigmoid, and a semilunar incision is made along the base of the bladder connecting the two lateral incisions.

" (4) Careful dissection of all the fat and glands as high as the abdominal aorta, the hollow of the sacrum being swept clean.

" (5) Ligation of the inferior mesenteric and middle sacral arteries at proper points.
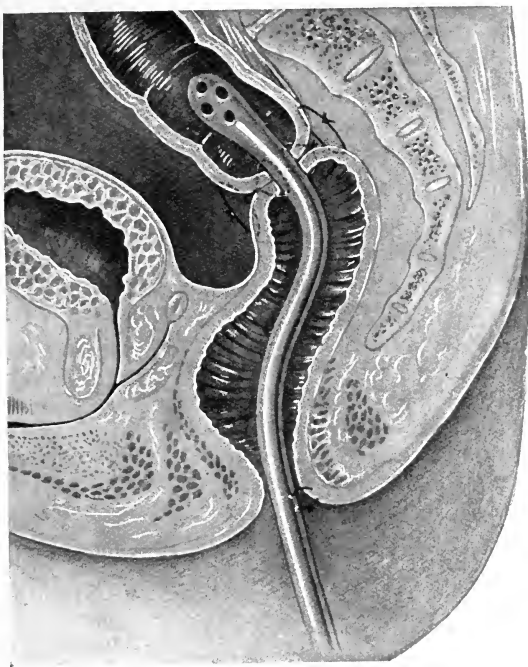
FIG. 360. Abdominal excision of a growth at junction of the pelvic colon and rectum. The tube is shown too small.

" (6) Two pairs of forceps are clamped on the bowel at a suitable distance below the tumour and two on the proximal side ; the necessary amount of sigmoid with the tumour excised, and the cut ends sterilised.

" (7) A ¾-inch rubber tube is passed into the lower segment of bowel until the end protrudes through the anus ; the upper end with lateral eye is inserted into the proximal end of the sigmoid to a distance of some three inches. It is here secured by a transverse catgut stitch half an inch above the cut end of the intestine.

" (8) Traction is made by an assistant upon the end of the tube projecting from the rectum, until the cut ends of the bowel meet, and the anastomosis is made by interrupted through-and-through chromic catgut sutures with careful co-aptation of the mucous membranes (Fig. 360).

" (9) Traction is again made upon the tube sufficient to accomplish a half-inch intussusception, this being aided by a few forceps on the distal fragment to steady it, and a second row of seromuscular sutures is inserted. Sometimes the parts are so deeply situated that the second row cannot be well placed, but the ultimate result has been good nevertheless.

" (10) The defect in the peritoneum behind is remedied by sliding the peritoneum and suturing, and finally the omentum is drawn down over the anastomosis, and if necessary secured by a catgut suture.

" (11) The abdominal wound is closed in the usual way, drainage being provided for, as a rule, by two wicks carried down on each side of the anastomosis into the hollow of the sacrum, and brought out the lower part of the abdominal incision. The rubber rectal tube remains in position about six days, until the catgut suture is absorbed. The abdominal drains are loosened on the fourth to the sixth day, but usually not removed for a week because a temporary fistula sometimes occurs."

After-treatment. The chief points here are to keep the wound clean by frequently syringing with peroxide of hydrogen $\frac{1}{3}$, the careful insufflation of iodoform, and the keeping all pockets dry. The patient is placed in semi-sitting attitude if possible to aid drainage. The catheter is generally required for several days, and a mild aperient may be given about the fourth day, if needed. When there is a risk of stricture, as after the perineal operation, the finger should be occasionally passed with the utmost gentleness, and after a week or ten days a bougie or vulcanite tube.

Causes of Trouble and Failure after Excision of the Rectum. (1) Shock. (2) Hæmorrhage. This will rarely be difficult to deal with at the time, or met with later, if the surgeon does the operation methodically and takes care to secure the vessels. Gauze packing is also very valuable in arresting both primary and secondary hæmorrhage in these cases. (3) Suppuration, cellulitis, and other septic troubles. (4) These, which cause 75 per cent. of the fatalities, can be largely prevented by carefully carrying out the preliminary treatment, and by preventing as far as possible any leakage from within the bowel into the wound during and after the operation. (5) Gangrene of the stump of the bowel from over-interference with its blood-supply or retraction of the superior hæmorrhoidal artery.[1] To avoid this care must be taken to preserve the blood-supply of the upper segment, and to see that its cut surface bleeds freely before it is joined without tension. (6) Exhaustion. (7) Recurrence. Freer excisions are required to lessen the frequency of this. (8) Sacral fistula. This may be *primary* from defective sutures of the bowel, or *secondary* from the formation of (9) a stricture after resection. (10) If the fistula does not close it must be submitted to a plastic operation. (11) Prolapsus. This may date to the operation, or to straining afterwards and yielding or bursting of the scar. This tendency will be met by the use of Mr. Paul's truss. When it occurs in the perineum a modified Whitehead's operation may be performed for its removal.

Mortality. Tuttle collected 1578 cases of extirpation of the rectum and sigmoid (pelvic colon) :

[1] Morestin, quoted by A. G. Gerster, *loc. supra cit., Gaz. des. Hôp.*, 1894, p. 326.

Method	Number of Cases	Deaths	Mortality
Sacral	913	211	23·1 per cent.
Perineal	569	76	13·5 ,, ,,
Abdominal	49	18	36·7 ,, ,,
Combined	22	9	40·9 ,, ,,
Vaginal	23	3	14·3 ,, ,,
Anal	2	2	100 ,, ,,
Total	1,578	319	20·2 ,, ,,

In 120 resections performed in various ways and recorded by Mayo [1] the mortality was 16 per cent. In 71 additional cases [2] the mortality was 15·5. The death-rate was maintained " due to the acceptance for operation of cases which previously would have been considered hopeless."

Resection of the Rectum and Rectosigmoid

January 1, 1910, to April 1, 1912 (Mayo).

POSTERIOR AND PERINEAL OPERATIONS.

	Number of Cases	Discharged	Died	Mortality per cent.
Local operation	2	2	0	0
Harrison Cripps	5	5	0	0
Quénu-Tuttle	12	11	1	8⅓
Posterior (Kraske) . . .	8	7	1	12·5
Total	27	25	2	7

ABDOMINAL OR ABDOMINAL COMBINED IN ONE OR TWO STAGES.

	Number of Cases	Discharged	Died	Mortality per cent.
Abdominal and abdomino-perineal: single stage	14	9	5	35
Preliminary colostomy with secondary posterior operation in two stages	30	26	4	13
Total	44	35	9	20

Five hundred cases have been operated on in the Vienna Clinic by the Hochenegg method with a mortality of 10·9 per cent., and 20 per cent. five-year cases. In his private work Hochenegg has a mortality of a little less than 10 per cent. Miles, in 42 abdomino-perineal resections, had a mortality of 40 per cent., but in 34 patients under 60 years of age the mortality was 26 per cent.

[1] *Ann. of Surg.*, 1910, vol. i, p. 855.   [2] *Ann. of Surg.*, 1912., vol. ii, p. 240.

The mortality of the abdomino-anal operation is probably about the same, but there is no large collection of published cases available. The writer lost 2 out of 7 cases. The patients who died were both over 60. One was 70 and died of shock, the other was 61 and died of cardiac failure fifteen days after the operation. Two of the five who recovered developed recurrences after two and four years respectively.

The Hope of Cure. Volkmann in 1878 claimed three complete cures, and several cases of very late recurrence—one after six, one after five and after three years. One died of carcinoma of the liver eight years after operation without local recurrence.

Hochenegg claims a 20 per cent. five-year freedom, and Mayo 30 per cent. five-year freedom. Hartwell found only 11 per cent. of 44 cases free of recurrence at the end of three years. With earlier operation and more radical methods it is to be hoped that at least 40 per cent. of cures may be obtained.

CHAPTER XLIII

RUPTURED PERINEUM

THE following account is taken from Dr. Galabin : [1]

A. **Operation for Partial Rupture** (Fig. 361). The patient is placed in lithotomy position. The need for assistants to support the thighs is avoided if a " Clover's crutch " is used.

" The extent of surface to be freshened is indicated, to some extent, by the cicatrix left by the rupture. It is well, however, to go a little beyond the limits of this in all directions, especially up the median line of the vagina and towards the lower halves of the labia majora, both in order to secure, if possible, a perineal body somewhat larger and deeper than the original one, and to allow some margin, in case the surfaces do not unite completely up to the edges. To put the mucous membrane on the stretch, an assistant at each side places one or two fingers on the skin of the thigh and draws the vulva outwards (Fig. 361). The skin just beneath A, in front of the anus, may also be seized by a tenaculum and drawn downwards. If still the mucous membrane is not sufficiently on the stretch, from laxity of the vagina, the posterior vaginal wall, some distance above B, should be seized by a vulsellum and pushed upwards. Incisions are then made through the mucous membrane from B to A, in the median line of the vagina, and from A to C and D through the junction of mucous membrane and skin. These should not be extended in the direction of C and D farther than the lower extremity of the nymphæ at the utmost. There are then two triangular flaps, ABC and ABD. These are to be dissected up from the apex A towards the base BC and BD, the corner of the mucous membrane at A being seized with dissecting forceps. The dissection should not be deeper than necessary, and if it is done with the knife the surfaces are more ready to unite. If, however, there is much tendency to bleed, scissors may be used. The apices of the flaps are then cut off with scissors, leaving an upturned border along BC and BD. When the surfaces are drawn together these borders form a slightly elevated ridge towards the vagina, and if there is any failure of union just along the edge they fall over and cover it.

" Silkworm-gut sutures are then placed as shown in the figure by means of Hagedorn's needles of half-circle curve. Another mode is to bury the sutures, 1, 2, and 3, in the tissues throughout their whole course. If, however, they are brought out in the centre for spaces alternately short and long (Fig. 361), the surfaces are more easily brought into contact at all levels without undue tension. In passing sutures 4, 5, 6, the needle should be brought out precisely on the margin along which

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[1] *Diseases of Women*, 1903, p. 618. Any one making trial of this method will agree with me as to its simplicity and excellent results.

the border of mucous membrane BD is turned up from the vagina, not passing through the mucous membrane itself, and passed in again on the corresponding spot on the margin BC, to be brought out so as to include the skin of the perineum. The sutures are then tied in the order of the numbers 1 to 6, care being taken that the surfaces are brought just sufficiently into apposition, and that no clots of blood are left between them. The bleeding, if any continues, is arrested by bringing the surfaces together, and if they are properly united there will be no secondary hæmorrhage, unless the sutures begin to cut from excessive tension. The sutures may be left in from seven to nine days."
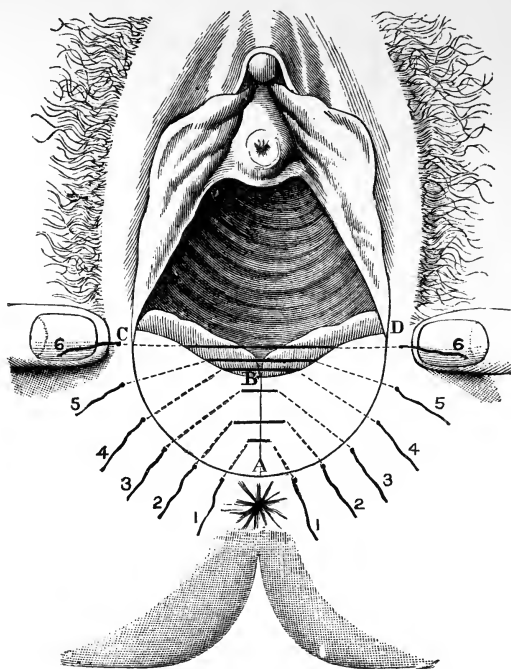
Fig. 361. (Galabin.)

Operation for Complete Rupture (Fig. 362). A sponge tied by a tape is passed into the bowel, and preliminary steps are taken as above. " A point B in the median line of the vagina, a sufficient distance above the apex of the rent in the septum, is taken, and an incision through the mucous membrane is made from B to G and from G to E and F along the edges of the septum, between the rectal mucous membrane and the cicatrix. Incisions are also made through the skin from E to C and F to D, so that the freshened surface may extend somewhat beyond the limits of the cicatrix left by the rent, C and D not to be higher than the lower extremities of the nymphæ. The quadrilateral flap EGBC is then seized at E by dissecting forceps, and dissected up with the knife from the angle E, and afterwards from the angle G, towards the base BC. While this is done, the parts are kept on the stretch by an assistant drawing down the skin below E with a tenaculum. The flap is then cut away with scissors, except an upturned border, which is left along BC. The flap FGBD is treated in a similar manner. If, as is usual, the ends of the

sphincter at E and F have retracted from the margin of the cicatrix, it is well to cut away with the scissors a narrow strip of rectal mucous membrane, generally somewhat everted, a short distance from E and F towards G, so as to bring the freshened surface to the ends of the sphincter.

"Sutures are then applied in the following manner: First, rectal sutures of chromic gut, either two or three, according to the extent of the rent in the septum, are applied. These are destined to be tied in the rectum, and left to be absorbed, the ends being cut short. They are best applied with Hagedorn's needle-holder and needle. The needle is passed in a little distance from the margin of the rent, and brought
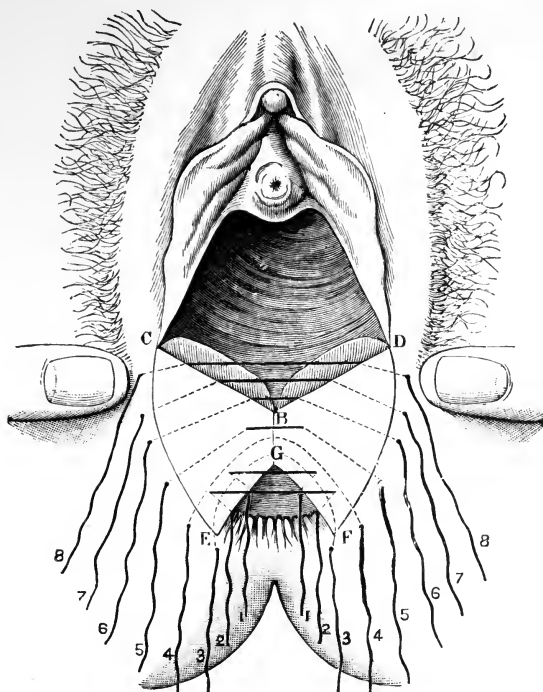
Fig. 362. (Galabin.)

out almost at the very edge of the rectal mucous membrane, on the line GF. The needle is then threaded at the other end of the suture, and that is drawn through in the same way from without inwards, emerging on the margin EG. The remaining sutures should be of stout fishing-gut. One or two sutures may be first passed completely round through the remnant of the septum by means of a Hagedorn's needle. The first of these (3, Fig. 362) is passed in somewhat behind and below the angle F, so as to take up, if possible, or at least go quite close to, the end of the divided sphincter, and is brought out in a similar position near E. Thus, when tightened, it brings together the ends of the sphincter, drawing it into a circle; but it often brings into apposition, not so much the freshened surfaces above as the unfreshened rectal mucous membrane. This serves as a barrier to keep out fæcal matter, while the next suture (4, Fig. 362) aids the rectal sutures in uniting the freshened surfaces. The remaining sutures are passed as shown in the figure (5—8, Fig. 362)

by a Hagedorn's needle, in the same way as in the operation for incomplete rupture. The needle is passed in pretty close to the edge CE or FD, and is brought out (except in the case of suture 5, Fig. 362) on the line where the margin CD or DB is turned up. On the opposite side it is passed in a similar way from within outwards. The effect is, that when the sutures are tightened the margins BC, BD, are turned up into a slight ridge towards the vagina, and afterwards fall over and cover any portion of the vaginal border which does not unite quite up to the edge. Suture 5 (Fig. 362) may either be buried throughout, or brought out for a very short space near the median line BG.

" When all the sutures are in place, the sponge is withdrawn from the rectum, and the rectal sutures are tied first. Care must be taken to draw up the whole of the slack in the centre, and bring the edges EG, FG, perfectly together. This will approximate the ends of the sphincter to a great extent, and the approximation is completed by tightening suture 3. The remaining sutures are then tied in the order of the numbers, care being taken to allow no clots of blood to remain between, and to tighten them just enough to bring the surfaces in contact. The ends of each perineal suture should be tied together, and left rather long, so as to be less likely to prick the skin. After three clear days an action of the bowels is obtained by a dose of an ounce of castor oil. Enemata should be avoided if possible, but may be necessary if a collection of fæces has formed in the rectum. Special care must be taken that no collection of hard fæces takes place for the first two or three days after removal of the sutures.

" The perineal sutures are removed in seven or eight days.

" In some cases, by the primary operation after labour, only superficial union is secured, and a recto-vaginal fistula is left close to the part united. The best plan is then to cut through the bridge of union with scissors at the time of the operation, and then proceed as in the case of complete rupture. This is the only way to secure a firm and thick perineum, and is less likely to fail than an operation on the fistula alone."

OPERATIONS ON THE OVARY

OVARIOTOMY

ONE or two **practical points** will be alluded to before the operation is described.

Date of Operation. An ovarian tumour should be removed as soon as possible after its discovery. For by delay not only is the patient subjected to the risk of accidents in connection with the tumour itself, but her general health is likely to suffer from the effects of pressure on neighbouring organs.

Accidents in Connection with Tumour. The accidents to which an ovarian tumour is liable should be borne in mind. They are, shortly, as follows :

(1) *Inflammatory Changes*. These, whether confined to the peritoneal covering or dependent upon inflammatory and necrotic changes in the cyst itself, will lead to adhesions between the tumour and the abdominal wall or viscera. When recent these adhesions may readily be separated, but when old and fibrous they may lead to serious difficulties in the course of the operation. The contents of the cyst may suppurate, and, fouling the peritoneal cavity, lead to suppurative peritonitis.

(2) *Torsion of the Pedicle*. When slowly produced, the interference with the blood-supply to the tumour will set up necrosis and so render the cyst wall liable to rupture. Acute torsion will lead to bleeding, which may be so profuse as to rupture the cyst wall and endanger the patient's life. Under these circumstances an immediate operation is called for, with all the disadvantages that an operation of urgency entails.

(3) *Rupture of the Cyst*. This may, as has been mentioned, follow necrotic changes in the cryst or torsion of the pedicle. It may, in addition, depend merely upon thinness of the wall or upon weakening due to the extension of growth from the interior through the cyst-wall. As a result the contents become disseminated through the peritoneal cavity, setting up peritonitis in certain cases, or leading to a general infection of the peritoneum with secondary growths in others.

(4) *Malignancy*. We have, finally, to remember this important practical point, that it is difficult at an early stage to say whether we are dealing with a malignant growth or not. It is especially in children that an early removal is demanded, for in them the proportion of malignant tumours is much higher than in adults. Mr. Bland Sutton found 21 cases of sarcoma in a series of 100 ovariotomies performed in girls under the age of 15.[1]

[1] *Surgical Diseases of the Ovaries and Fallopian Tubes*, 1896, p. 178.

General Condition of the Patient. The condition of the viscera, kidneys, lungs, &c., the habits of the patient, her digestive powers, must all be carefully noted. For upon a consideration of these points not only does the prognosis to some extent depend, but also the nature and duration of the treatment to be adopted preparatory to the operation. Age need not be regarded as a bar to operation. Mr. Bland Sutton has collected 11 cases of ovariotomy in women over 80, all of whom recovered.[1] The presence of albumen in the urine should not be regarded as necessarily a contraindication to operation. Small amounts often clear up after the removal of the tumour. If chronic nephritis is known to be present, the operation should still be carried out, in most cases, after suitable preliminary treatment.

As regards difficulties likely to be met with in the course of the operation, some information will be obtained from the history of the patient and from careful examination. Attacks of pain will point to peritonitis and adhesions. An examination of the tumour will give some idea of its mobility, of the proportion of solid matter, &c.

The *amount of skill of the surgeon*, though a delicate matter, must also be mentioned. No one should operate on these cases who has not had good opportunities of seeing others operate frequently, and no one should undertake a case whose ovariotomies are, at the most, likely to be but two or three in his lifetime

Preparation of the Patient. The patient should be kept quiet for two or three days before the operation in an ordinary uncomplicated case, and the bowels regulated. The diet need not be unduly restricted or altered beyond seeing that it is easily digestible and nutritious. One or two warm baths may be taken for a day or two before the operation. On the evening preceding the operation, the pubes should be shaved and the abdomen thoroughly washed, attention being paid particularly to the navel. A compress of 1 in 2000 perchloride of mercury should then be applied. A purge should be given overnight, followed by an enema in the morning. On the day of operation a light breakfast should be taken, and some beef-tea or soup about ten, if the operation is to take place about 2 P.M. When the patient, warmly clad, especially as to her extremities, comes in to take an anæsthetic, only two or three faces that are familiar to her should be present; when she is under the anæsthetic, a catheter should be passed, if the bladder has not been emptied beforehand.

The Operation. *Incision of Abdominal Wall.* An incision in the median line, reaching from just below the umbilicus to within two inches of the pubes, is made through skin and fat. There is no object in having the incision more than four inches long to commence with, as it can be lengthened as required subsequently. After dividing the skin and fat the layer of fascia which forms the sheath of the recti muscles comes into view. If the muscles are in apposition, one or both of them will be exposed on incising the fascia; the interval between them should be sought for, and the two muscles separated for the length of the incision. If the linea alba is missed, and a difficulty is experienced in finding the median line, a director or the handle of the scalpel should be introduced beneath the fascia; the director will be arrested on the side on which the linea alba lies.

If the recti are separated, an incision through the fascia in the median

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[1] Bland Sutton, *loc. cit.*, p. 175.

line at once exposes the subperitoneal fat and peritoneum. Before this is incised Spencer-Wells forceps are applied to every bleeding-point; these may be left on until the operation is concluded; any bleeding-points then persisting should be treated by torsion, and not by ligatures, as these latter weaken the cicatrix. The peritoneum, readily recognised, when healthy, by its delicate fasciculation and translucency, is carefully picked up by a pair of forceps so as to include nothing else, and incision is made in it horizontally with a knife. As soon as the peritoneal cavity is opened the intestines fall away from the abdominal wall. The peritoneum is then slit up on two fingers for the length of the incision; the fingers, used in this way as a director, are enabled to detect the height to which the bladder comes at the lower part of the wound, and so to determine the limit to which the peritoneal incision may safely be carried below.

Mr. Doran [1] thinks a mistake is often made in not bringing the incision near enough to the pubes, which may cause much trouble when the pedicle has to be drawn out, and greatly impede a thorough exploration of the pelvis.

Care should be taken not to mistake the subperitoneal fat for omentum, as this may lead to extensive stripping off of the peritoneum from the abdominal wall, an accident likely to be followed by sloughing of this structure.

In an easy case without parietal adhesions the pearly glistening cyst comes into view as soon as the peritoneum is incised; but if the peritoneum is thickened and adherent to the cyst there may be the greatest difficulty in deciding when this is reached, and the incision may even be carried through the cyst wall. In cases of difficulty the incision should be prolonged upwards to the left of the umbilicus until a spot free from adhesions is found.

When the tumour is exposed it should be examined carefully by eye and hand. Its nature should be noted, whether cystic or solid, or partially solid, whether a dermoid or inflamed; the presence of adhesions should be ascertained, or secondary malignant deposits, rendering further operation inadvisable. If we are dealing with an uncomplicated cystic tumour of the ovary, the first proceeding is to tap it.

Emptying the Cyst. The abdominal incision should be packed round to prevent fluid running back into the abdominal cavity. The cyst is next tapped by carefully plunging in a Spencer-Wells trocar, then guarding the point with the inner tube, and as soon as the walls of the cyst are rendered lax enough by the escape of the contents attaching the claws to the cyst wall, so as to keep this on the trocar, a forward traction is made. A trocar and cannula with a long curve does equally well, the cyst wall being drawn forward with Spencer-Wells forceps as soon as it is rendered lax by the escape of the fluid contents.

Dr. Baldy [2] points out that the puncture should not be made at the lower angle of the wound, for the reason that as the cyst empties it retracts, and leaves the opening situated below the wound, increasing the difficulty of preventing fluid from entering the peritoneal cavity. As soon as the trocar is inserted into the cyst, the assistant should place a hand low down on each side of the abdomen, and press steadily and firmly. By this means he not only forces out the fluid from the cyst, but keeps the abdominal incision taut over the tumour, thus preventing

[1] *Ann. of Surg.*, May 1888   [2] *Syst. of Gynæcol.*, 1894.

the contents of the cyst from running into the peritoneal cavity. As the cyst empties traction is applied to it by means of the claws of the trocar or by other forceps, and if there are no adhesions it is readily brought out of the wound.

If there is difficulty in delivering the tumour, and it is clear, from the bulk of the cyst remaining after tapping, that it is multilocular, it will have to be further reduced in size before extraction. If it is multi-locular, it must be tapped again in two or three more places by removing the trocar and closing the puncture with cyst forceps, and then, while the cyst is dragged forward and steadied, the first trocar or a smaller one is thrust in at other spots where fluid is still present. This is a better practice than thrusting the trocar from the first puncture into other parts of the cyst in the dark. If this latter method is adopted, the hand should first be passed into the abdomen to make sure that the trocar does not perforate the cyst wall and injure the viscera. In cases in which the tumour is composed of a large number of small cysts, or in which the contents are so viscid that they will not escape through the trocar, the opening may be enlarged and the hand passed into the cyst to break down the numerous septa or scoop out the viscid contents. This procedure is likely to be attended with the escape of the contents of the cyst into the abdominal cavity, and also where solid material is present, more particularly in the form of intracystic papillary growth, with bleeding that may be very profuse. A much more satisfactory plan is to enlarge the abdominal opening until the tumour can be with-drawn entire. This method of removal of the cyst without tapping may, with advantage, be applied also to all cysts of small and medium size. Any dermoid recognised as such should be removed entire, as the oily contents have a very irritating effect if allowed to escape into the peritoneal cavity.

Treatment of Adhesions. As the cyst is emptied and drawn forwards, any adhesions that are present must be dealt with, and the ease with which they are separated will depend upon whether they are recent or not. Those between the tumour and abdominal wall are readily separated, when recent, by sweeping the hand between the two adherent surfaces. If of longer duration the separation must be effected, bit by bit, with the finger-nail or scissors, any persistent bleeding-points being secured by Spencer-Wells forceps and tied. Another method is to underrun any bleeding-points, especially any obstinate ones in the parietal peritoneum. Adhesions to the omentum, which are the most common, must be ligatured and divided, the number of ligatures used depending on the extent of the adherent omentum. Mr. Herman [1] points out that holes frequently exist in large pieces of adherent omentum, and he advises that in cutting the omentum away the incisions should be carried through these holes to obviate any subsequent risk of intestines being strangulated in them. Intestinal and other visceral adhesions may present considerable diffi-culties. If the bowel is adherent it should be very carefully peeled by means of the thumb-nail from the cyst. If it cannot be detached in this way a thin strip of the cyst wall should be cut away and left adherent to the intestines. Firm adhesions in the pelvis present the most diffi-culty, and in the separation of them by means of the fingers a hole may be torn in the rectum. Injury to large vessels is not common. In Dr. Baldy's *Gynæcology*, however, a case is recorded in which death

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[1] *Diseases of Women*, 1898, p. 797.

resulted from hæmorrhage due to injury of a large vein in the removal of an ovarian cyst. Though bleeding from large vessels is not common, it is especially in cases of extensive pelvic adhesions that we get troublesome oozing. Temporary plugging with sterilised gauze may arrest this, but should it fail, an attempt should be made to seize the bleeding-points with forceps and secure them with ligatures. This procedure will be much facilitated by having the patient in the raised pelvis position. If bleeding cannot be arrested by these means the pelvic cavity should be firmly packed with long strips of sterilised or iodoform gauze, the ends of which are brought out through the lower part of the wound. The sutures should be introduced as usual into the lower part of the abdominal incision, but should be left untied, ready to bring the edges of the wound together when the plug is removed. The gauze should be taken out twenty-four hours after the operation. By that time it will have served its purpose, the arrest of the oozing.

FIG. 363. (Doran.)

Treatment of Pedicle. When the cyst has been sufficiently brought outside, the pedicle is dealt with.

The centre of the pedicle being found by unfolding it, a blunt pedicle needle loaded with silk (No. 4) or catgut is made to perforate it here at a spot devoid of vessels. The loop of silk being drawn through and the needle withdrawn, the loop is cut, and the two ligatures tied firmly round the two halves of the pedicle. The cyst is then cut away, not more than three-quarters of an inch and not less than half an inch, from the ligatures. When this is done, the cut end is carefully examined, to make sure that no bleeding is taking place. The pedicle is then allowed to drop in, and the finger, following it down to the uterus, finds and hooks up the other ovary. If this is found to be similarly affected it must be removed. When the pedicle is very broad, a second or a third transfixion will be needed. The second must be thus performed: The thread for the outer loop (*a*, Fig. 363) is twisted on one side of the pedicle round the outer thread (*b*); then the outer loop is tied. The pedicle-needle (a long unhandled one with a large eye is the best) is then threaded, first with a single ligature (*c*), and then with one end (*b*) of the untied thread already passed through the pedicle. The transfixion is then performed (Fig. 363). The third thread (*c*) must be once twisted around the second (*b*); this is best done, perhaps, on the side where (*b*) forms a loop (Fig. 363). Then, on the opposite side, the two free ends of the second thread (*b*) are firmly tied. The ends of the third thread (*c*) are then tied on the inner side of the pedicle. The threads will then lie as in Fig. 364, firmly interlocked and holding the pedicle tightly. Should a third transfixion be required, the third thread, instead of being tied, must be threaded on the needle in company with a fourth, and the process
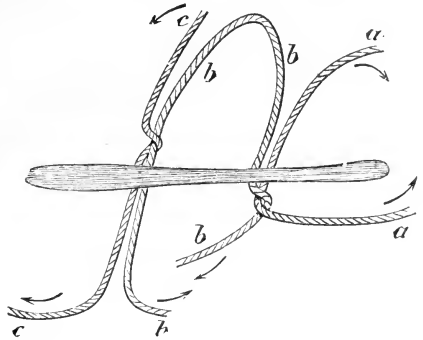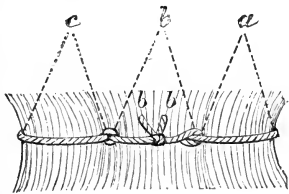
FIG. 364. (Doran.)

just described repeated, care being taken to interlock the threads as before. If this precaution be not taken, the unlocked threads pulling in different directions will tend to tear the pedicle apart at the point of transfixion, and vessels may easily escape being commanded. As each of the above loops is tied, the ends of the thread must be cut short, or needless confusion will be entailed.

The Toilet of the Peritoneum. The operator now scrutinises the parts, removes any jagged omentum or bands of adhesions, arrests any still bleeding-points, takes out any sponges which he may have inserted, and has them all counted. The next step is to sponge out thoroughly the pelvis, the spaces in front of and behind the uterus, and those on either side of the vertebral column. This is effected by introducing again and again aspetic sponges or sterilised gauze swabs on sponge forceps until they return dry and colourless. In the great majority of cases this will be sufficient, and many operators employ practically no other procedure. If, however, a cyst has burst during the handling of the tumour, as sometimes happens when the wall is thin or necrotic, and viscid contents or, perhaps, papillary growths have escaped into the peritoneal cavity, it is difficult without undue manipulation of the viscera to get the abdominal cavity clean. Under these circumstances it is preferable to wash out with warm sterilised water, or sterilised water to which ·6 per cent. of common salt has been added. This is especially indicated where growth has escaped into the peritoneal cavity from a papillary cyst, on account of the possibility of reinfection from a portion of growth left behind.

Suture of Abdominal Wound. The abdominal wound may be closed either by using one row of sutures which pass through skin, muscle, and peritoneum, or by securing the different layers separately. One row only of sutures should be used in cases in which drainage is employed, or in which the contents, though freely removed, were septic, or, again, in cases in which a second operation appeared probable. The introduction of a single layer is effected as follows : A flat sponge being introduced to catch any blood, the abdominal wound is closed by means of sutures of stout silkworm gut. These should be carried through peritoneum, muscle, and skin, care being taken that the stitches pass through the peritoneum within a quarter of an inch of its edge, so that this structure is not tucked in between the surfaces of the wound. Not only should a good bunch of muscle be included, but also the fibrous sheath overlying it. The sutures should pass through the skin about a third of an inch from the edge of the wound, and they should be inserted about half an inch from each other. When all the sutures have been introduced they are collected near their ends on either side with pressure forceps. The operator then parts the sutures, hooking them up and down so as to obtain free access to the abdominal cavity without any risk of pulling out a suture. The flat sponge is now withdrawn and the sutures tied, care being taken that neither omentum nor intestines become caught in the loop. Superficial sutures of fine silk or horsehair should be employed accurately to coapt the edges of the skin.

If the layers of the abdominal wall are to be sewn up separately, the first procedure is to shut off the peritoneal cavity by bringing the edges of the peritoneum together with a continuous suture of fine silk, or preferably catgut. The recti are then approximated either by a continuous or by interrupted sutures of the same material, care being taken

to bring together the edges of the fibrous layer overlying the muscle. The edges of the skin are finally sewn together in the same way. The modifications of these two methods made use of by different surgeons are numerous. I prefer first of all to unite the edges of the peritoneum with a continuous fine catgut suture. Interrupted silkworm-gut sutures are then passed through skin, fascia, and muscle, the edges of the skin being brought into careful apposition with a continuous horsehair suture after the interrupted silkworm-gut sutures have been tied.

Drainage. Different operators vary much in their practice as regards drainage, and it is difficult to lay down any hard and fast rules as to when to employ it. Undoubtedly the tendency is to employ it less and less. Experiments carried out within the last few years on the absorptive powers of the peritoneum have taught us that this structure, when in a normal condition, is capable of absorbing large quantities of fluid and also of disposing of a considerable number of pyogenic organisms introduced into the abdominal cavity. We have to bear in mind, however, that a peritoneum thickened by inflammation, such as we find in some cases of ovarian tumour, has its functions impaired, and is not in a condition to dispose of large quantities of fluid or many organisms. Consequently fluid collecting in the abdominal cavity provides a ready medium for the growth of any organisms accidentally introduced.

Dr. Jellett [1] puts this question of drainage very clearly. " It must be regarded," he says, " as a line of treatment whose general effect is by no means beneficial, but which may have to be used at times in order to guard against a greater danger." The risks of drainage should be clearly recognised. One serious result is the weakening of the abdominal scar that attends its use, with the subsequent formation of a hernia. The drain may be a cause of reinfection of the abdominal cavity, and when a hard glass tube is employed, may, by pressure on the bowel, lead to the formation of a fæcal fistula. There is one condition in which drainage is certainly called for, and that is when any septic material, as from a suppurating cyst or a pyo-salpinx, has entered the peritoneal cavity, or when any septic focus has been imperfectly removed.

Drainage is less often made use of after the separation of extensive adhesions. In such cases the surgeon must use his own judgment. He should bear in mind the fact that the absorptive powers of the peritoneum in such cases are impaired, and if he thinks that more exudation is poured out than the peritoneum can deal with, he must employ some form of drainage. For this purpose a glass tube (Keith's) is commonly made use of . One end rests at the bottom of Douglas's pouch without pressing on the rectum ; the other passes through a thin sheet of india-rubber, its neck being firmly gripped by a hole in this. One or two sutures should be passed in the usual way through the abdominal wound, above and below the tube, but left untied until the tube is removed. A gauze swab is placed on the end of the tube to absorb discharges, and the india-rubber sheeting wrapped round it to prevent soiling of the dressings. Every two or three hours the fluid should be sucked out of the drainage-tube by means of a glass syringe with a piece of india-rubber tubing attached. The syringe and tubing should be boiled before being used, and the most scrupulous precautions taken against the introduction of organisms from without. It is difficult to lay down rules with regard to the length of time drainage should be employed. When used on account

[1] *Pract. of Gynæcol.*, 1900, p. 287.

of oozing from extensive raw surfaces one to two days will usually suffice. When, on account of some septic condition, drainage is required for a longer time, the glass tube should be replaced in two days' time by a rubber one. Mr Herman recommends that it should be so replaced at the end of twenty-four hours in all cases where longer drainage is required. Owing to the fact that a hard tube is likely to produce a fæcal fistula by pressure on the bowel, and owing to the danger of reinfection that attends its use, many surgeons have discarded it, and now employ gauze instead. Either sterilised or iodoform gauze may be used. It should be cut into strips and its edges turned in and sewn together to prevent the possibility of shreds being detached and left behind in the wound. As it soon ceases to act as a drain, it should be removed twenty-four to forty-eight hours later, fresh strips being replaced if necessary. For drainage through the abdominal wound gauze is not altogether satisfactory. It soon fails to act, necessitating renewal, and it appears to set up more adhesions than a glass tube. The advantages in certain cases of drainage through the vagina are pointed out by Dr. Jellett,[1] and he considers that with a healthy vagina drainage through the bottom of Douglas's pouch is the correct treatment in the majority of cases. It does not weaken the abdominal wound, and drainage is carried out from the most dependent point of the abdominal cavity. The vagina is opened through the pouch of Douglas on the separated points of a pair of forceps pushed up by an assistant into the posterior fornix of the vagina. A strip of iodoform gauze should be passed through the opening from Douglas's pouch into the vagina, about half an inch of the gauze being left projecting into the peritoneal cavity. The remainder of this strip is left packed in the vagina, and should be removed in two or three days' time. In spite of its advantages I do not care for vaginal drainage. As with all gauze drains adhesions are so quickly formed, that it soon ceases to act. Moreover the pouch of Douglas is not always opened easily into the vagina. For drainage I still prefer the Keith's tube passed to the bottom of Douglas's pouch to all other forms. It allows of all fluid draining into Douglas's pouch to be removed at frequent intervals. It is very little irritating and causes fewer adhesions than gauze. Its removal is attended with none of the distress that accompanies the gauze packing. So long as it does not exert pressure on the rectum, and is not left in too long, the risks of a fæcal fistula are very small. On its removal in twenty-four to forty-eight hours, the wound edges can generally be allowed to fall together, and I believe subsequent hernia to be unusual.

Encapsuled Ovarian Cysts. Cysts of the Broad Ligament. Intra-ligamentous Cysts. Cases are occasionally met with in which the cyst growing between the layers of the broad ligament is imperfectly encapsuled and has no pedicle that can be ligatured. In these cases an attempt should be made to enucleate the tumour after making an incision through the peritoneal covering. Mr. Thornton[2] has pointed out the advisability of isolating at an early stage the vessels and ligaturing them. Dr. Kelly,[3] who also draws attention to the importance of securing the vessels early in the operation, points out that the blood-supply is derived from the ovarian and the terminal branches of the uterine vessels, and that these should be sought for, the former on the side of the pelvic

[1] *Loc supra cit.*   [2] *Dict. Surgery*, vol. ii, p. 155.
[3] *Oper. Gyncœol.*, 1898, vol. ii, p. 303.

brim, the latter on the uterine side of the cyst, after division of the peritoneum. If these are tied at once there need be but little hæmorrhage throughout the operation. The main blood-supply having been secured in this way, the tumour should be enucleated by separating with the fingers the loose connective tissue that holds it in position. The removal of the cyst will be facilitated by emptying it of its contents with a trocar in the usual way. Any bleeding-points in the capsule should be seized with pressure forceps and secured. "In performing these enucleations the operator must always bear in mind the fact that he is constantly brought into dangerously close relations with bladder and ureters, rectum and sigmoid flexure, or cæcum and appendix. The large iliac vessels are also occasionally incorporated with the capsule." [1]

After the removal of the cyst the capsule requires attention. If it is very redundant it may be gathered up into a loose fold, transfixed and tied, like an ordinary pedicle.[2] If the cavity is small, and there is no oozing, the cut edges of the peritoneum should be drawn together by a continuous silk ligature. If, however, there is much oozing, the edges of the capsule should be secured to the lower part of the abdominal wound, and its interior packed with gauze strips. Sometimes it is found that the cyst is so firmly attached to important structures that its removal becomes an impossibility. The edges of the cyst and the capsule must then be attached to the abdominal wound, and the cavity drained. Such a procedure is not entirely satisfactory, as the cyst is likely to refill later. When intraligamentary growths occur on both sides, Dr. Kelly considers that it is easier and better to remove uterus and tumours together, the method adopted being practically the same as that employed by him for hysterectomy.

Incomplete Ovariotomy. The surgeon may be compelled, very early in the case, to abandon his operation. This will be rendered necessary by the following conditions : (1) When the tumour is malignant and has infiltrated tissues which cannot be safely removed, or when secondary nodules are found in the abdominal cavity. (2) When the peritoneum is found covered with papillary growths, the result of infection from a papillary cyst. Dr. H. A. Kelly [3] advises removal of the mother-tumour whenever it is possible, as he considers it not only relieves the pressure of the ascites, but checks the rapidity of the growth. Moreover, cases have been recorded by Mr. K. Thornton and others where a disappearance of the secondary papillary growths and a freedom from recurrence have resulted from this line of treatment. (3) When the base of the cyst, whether intraligamentary or not, is irremovable, deep in the pelvis, and adherent to the ureters, large vessels, or adjacent viscera. The surgeon must then empty the cyst of its contents, and suture its cut edge to the abdominal incision, all superfluous portions of the cyst being cut away. Before doing this he must check all hæmorrhage, inspect any possibly damaged viscera and carefully cleanse the back of the tumour and the parts behind it. The remains of the cyst, after being carefully sutured to the lower part of the abdominal incision so as to entirely shut off the peritoneal cavity, should be packed with iodoform gauze.

Accidents during Ovariotomy. (1) *Syncope.* This appears to be brought about in some cases by too rapid emptying of large cysts. The

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[1] Mr. Thornton, *loc. supra cit.*
[2] Mr. Bland Sutton, *Surg. Dis. of Ovaries*, 1896, p. 372.
[3] *Loc. supra cit.*, vol. ii, p. 294.

pressure on the abdominal vessels is relaxed, and they become filled with blood at the expense of the rest of the body. This accident should be avoided by slowly drawing off the contents of large cysts. When it occurs it should be treated by lowering the head, keeping the patient warm, and administering brandy subcutaneously.

(2) *Vomiting.* This chiefly harasses by straining the intestines out of the abdomen. If prolonged, the operation must be completed as soon as possible, an assistant keeping the viscera in place with a flat sponge or gauze pad.

(3) *Separation of the Parietal Peritoneum.* It has already been pointed out that this is due to the operator mistaking the subperitoneal fat for omentum. It is an accident that may be avoided by care.

(4) *Rupture of the Cyst.* This accident may be expected when the walls are thin, necrotic, or softened by recent inflammation. In such cases the cyst should be carefully handled, suspicious spots being kept well out of the wound or packed around with sponges. If rupture occurs, the abdomen should be well irrigated with warm boiled water, and if the contents of the cyst are suppurating, drained subsequently.

(5) *Injuries to Viscera.* Of these the bladder, small intestines, rectum, and ureter are most likely to suffer. The bladder may be injured during the abdominal incision owing to its being drawn up. This, however, is not so likely to happen as in operations for fibroids. Or it may be opened in the course of removal of the tumour. Treatment consists in immediate suture of the organ, and subsequent drainage by catheter to prevent distension. The intestine is most likely to be injured in the separation of adhesions. When possible the wound in the bowel should be at once sutured. If the damage is more extensive the question of resection of a portion of gut will arise. The rectum is sometimes torn in the separation of firm adhesions in the pelvis. The operator should attempt to sew up the rent, a proceeding that will be much facilitated by the raised pelvis position and a good light. Often suturing will be found to be impossible, and in such case the neighbourhood of the injury should be well packed with iodoform gauze, the ends of which are left out of the abdominal wound, or through an opening in the vaginal vault. Sloughing of the bowel sometimes occurs after the operation, leading to the formation of a fæcal fistula. This is owing in some cases to injury of the intestine during the operation, in others to the pressure of the glass tube used for drainage. For the treatment of cases in which the ureter is injured the chapter on that subject should be consulted (p. 592).

(6) *Severe Hæmorrhage.* It has already been mentioned that severe or fatal hæmorrhage from injury to large pelvic vessels is rare. Very severe and even alarming hæmorrhage may, however, take place from the cyst wall or its interior. This is especially likely to happen when the solid contents of a papillary cyst are being scooped out by the hand. If the pedicle can be got at readily and ligatured, this should be done quickly. If not, the advice given by Dr. H. A. Kelly [1] should be followed : " The only safe plan is to control at once the main vessels going to the tumour by applying artery forceps to the broad ligament at the pelvic brim so as to catch the ovarian vessels, and one or two pairs at the uterine corner to catch the uterine vessels."

(7) *Leaving in Instruments.* *E.g.* sponge or forceps. The fact that this accident has occurred with operators of the largest experience

[1] *Loc. supra cit.,* p. 296.

should make all careful. It is best met by having a sufficient definite number to begin with and counting carefully afterwards.

After-treatment. As soon as the patient recovers from the anæsthetic she should be gradually raised in bed by means of pillows placed behind her back, until she is supported in a sitting posture. Nothing has more effect in the relief of flatulence than this procedure. If a glass drainage-tube is made use of, she must be kept on her back till the tube is removed. The most careful attention should be paid to the bedding under her, and the nurse should see that there are no creases in the mackintosh or sheets. A few wrinkles will cause the patient the most acute discomfort.

The retching and vomiting that patients suffer from after an abdominal operation is considerably more than the anæsthetic alone will account for. Drugs should not be employed to combat the sickness. In fact, they will generally be found to be useless. The proper treatment of the stomach is rest during the first twenty hours. The only thing that should be given by mouth during this time is hot water, and of this a tablespoonful may be taken at a time as hot as can be borne comfortably. This will be found to be most acceptable to the patient, reviving her, and often removing the feeling of faintness. Ice should not be given either for the sickness or to allay thirst. The iced water remains unabsorbed in the stomach, and is sooner or later rejected. For the relief of thirst, more particularly in those cases in which nothing can be retained in the stomach, recourse should be had to " rectal salines " A pint of normal saline solution given slowly by the bowel two or three times in the first twenty-four hours after the operation, will do away with the great distress from this cause. At the end of twenty-four hours small quantities of nourishment may usually be given. It is difficult to lay down rules with regard to quantities. In a straightforward case two drachms of milk, which has been peptonised beforehand, may be given every half-hour to commence with, and the quantity gradually increased. Albumen water, made by dissolving the white of an egg in half a pint of water, may be given, mixed in equal quantities with the milk.

It is a good thing to get the bowels open early. Forty-eight hours or even earlier after the operation, an aperient should be given. Nothing is better for this purpose than an ounce of castor oil, given with a little brandy. This should be followed in eight hours by a soap enema, containing four ounces of olive oil. If the patient is comfortable and the purge does not act, leave her alone for a time and repeat the enema later. It is a mistake to keep on giving purgatives, more especially calomel, which may set up severe or even fatal diarrhœa when it does act. The unloading of the bowels will, as a rule, make the patient more comfortable, relieve flatulence from which she may have been suffering, and allow her to take more nourishment. The patient should be allowed and encouraged to pass her water naturally after the operation. If she cannot do so a catheter should be passed at the end of twelve hours, every possible precaution being taken to prevent infection of the bladder.

The routine use of opium in any form is to be avoided. On this subject I cannot do better than quote the late Mr. Greig Smith's words : " All medicines are, if possible, to be avoided, particularly opium. Pain I believe to be not so strong an indication for opium as restlessness. Sickness and tympanites are predisposed to, if not often caused by, opium. One expects, after the first dose has been administered, to see the patient wake up in the morning with a dry tongue, increased thirst,

and some feeling of nausea, which during the day do not pass off, but culminate in restlessness at night, requiring the administration of a second dose. We rarely see a case treated throughout with a perfectly flat or retracted abdomen if opium has been administered. When the patient tosses about in bed, fidgety and restless, without any particular symptoms beyond those incident to a serious operation, opium is undoubtedly of great value." [1]

REMOVAL OF THE UTERINE APPENDAGES [2]

Indications. [3] Before giving these, I would state that there is no operation in which it is more necessary to consider each case on its own bearings, to explain the object and results with honourable carefulness to the friends and, whenever possible, to the patient herself, and to remember that this is above all one of those operations which should never be entertained if there are any honest doubts as to the patient's health being really impaired beyond the aid of other treatment, and the impossibility of otherwise restoring her to usefulness in the position of life in which she has been placed; and that it is an operation which may concern the happiness of another besides that of the patient. Due weight must be given to the large part played by neuroses in this matter, and to the fact that till we have carefully published cases in which the results have been submitted to the only true test, that of time, we shall not be in a position to decide how far the after-condition of a great number of the patients who have been submitted to this operation is one of improvement. Finally, it is always to be remembered that it is an operation which has been greatly misused.

The following is a limited list of indications for removal of the uterine appendages :

(1) **Diseases of the Fallopian Tubes and Ovaries.** Of these the inflammatory affections concern us chiefly, in the form of salpingitis, pyo-, hydro-, or hæmato-salpinx, ovaritis, ovarian abscess, or tubo-ovarian abscess. Other diseases include ovarian new growths which have been considered under the heading of ovariotomy and tumours of the Fallopian tube, which do not call for separate treatment. It is not easy to make rules for guidance that will apply to all cases of inflammation of the appendages. Every case demands careful consideration on its own merits. The broad lines of treatment may, nevertheless, be indicated ; they are not unlike those that guide us in the treatment

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[1] *Abdom. Surg.*, 1896, vol. i, p. 210.

[2] This term has been used here for convenience' sake, as more comprehensive than " oophorectomy," &c.

[3] A paper read some years ago at one of our medical societies, and the discussion thereon, has brought this matter prominently before the profession. I would strongly advise my younger readers to study carefully a very weighty letter in the journals of February 7, 1891, bearing the well-known signatures of Sir John Williams and Dr. Champneys. Every sentence will well repay perusal. I quote a few : " Perimetritis is probably the very commonest of all the serious diseases of women. It is also perfectly certain that the great majority of cases get quite well without any operation. We are far from denying that exceptional cases call for surgical procedures, or that cases of prolonged suppuration in the pelvis are properly treated by the application to them of ordinary surgical principles. But this wholesale resort to a mutilating operation, advocated by several speakers at these discussions, calls for serious consideration by the profession. . . . A plea for patience is to be found in the declaration of the operators that the full benefits of the operation are not felt for months or years after. If the operator would exercise this patience before the operation there might be less need for its exercise by the patient after the operation."

of appendicitis. In the following indications, Mr. Cullingworth [1] is closely followed :

(*a*) *Operation during Acute Attack*. It is not often that surgical interference is called for during an acute attack. The difficulty, and more especially the danger, of the operation is increased during this stage. Moreover, the advisability of treating the inflammation, when acute, by rest is shown by the generally good results obtained. Even if pus is suspected, the surgeon should not be in too great a hurry to operate. One well-defined indication for interference during the acute attack has been laid stress on by Mr. Cullingworth, and that is the accumulation of fluid, more especially if it be purulent, in suffcient amount to distend Douglas's pouch and encroach on the vagina and rectum. Here " there can be no hesitation as to the propriety of making an opening through the vaginal roof. Such timely interference will not only afford immediate relief to the more urgent symptoms, but will prevent the bursting of an abscess into the rectum."

(*b*) *Recurrent Attacks*. A history of recurrent attacks of peritonitis almost invariably means the presence of pus. If, with this history, the patient has a swelling which has " attained such dimensions as to make it fairly certain that in the midst of it there is either an occluded and distended Fallopian tube, or an ovary enlarged by cystic growth, the indications for the removal of the disease are perfectly clear."

(*c*) The *class of life* to which the patient belongs must be considered. A woman who has to earn her living cannot afford to submit to prolonged treatment by rest, if by operation she can secure a more rapid recovery.

(*d*) *Persistence of Symptoms after Acute Attack*. In most cases, with rest and appropriate treatment, the inflammatory mass subsides, the pain disappears, and the patient is restored to health. It occasionally happens, however, that the symptoms persist, and unless some relief is afforded the patient, there is danger that she will drift into a condition of chronic invalidism, and become unfit for any of the ordinary vocations of life. These cases present many points of difficulty, and the treatment to be adopted must depend upon the existing condition. Should it be found that the inflammatory mass, instead of subsiding, persists, the advisability of operating will have to be considered. But before resorting to an operation that involves removal of tubes and ovaries the question of how long expectant treatment should be persevered in presents itself. The class of life of the patient, as a factor to be taken into consideration, has already been mentioned. Mr. Herman, in answering this question, gives the following practical advice :

" Most cases will get well within two months ; but I have seen expectant treatment followed out for two months without relief, and then the patient has begun to improve. I therefore think that three months is the minimum which in doubtful cases should be considered a fair trial of expectant treatment. This is only a statement as to most cases, not a rule to be applied to every case." [2] On the other hand, the inflammatory mass may have subsided as the result of treatment but pain persists, and we find on examination that the pelvic organs are displaced and fixed by adhesions. Under these circumstances greater patience must be exercised, and the necessity for removal of

[1] *Syst. of Gyn.,* Allbutt and Playfair, 1896, p. 514.
[2] *Diseases of Women,* p. 240.

the appendages most carefully considered before such a method of treatment is adopted. In some of these cases a conservative operation may be advantageously practised, and proceedings limited to thorough freeing of adhesions and fixation of the organs in better position. And, lastly, we meet with cases in which the pain does not appear to have sufficient physical basis to justify us in recommending any operation.

(2) **Fibro-myoma of the Uterus.** Oophorectomy no longer occupies the position it did in the treatment of fibroids ; its place has been taken by hysterectomy, and there are several reasons for this. The removal of the ovaries is not followed by uniformly satisfactory results, though, as Mr. Doran points out, we can never feel sure, in cases of failure, that all the ovarian tissue has been removed. As, however, some fibroids may go on growing and may require hysterectomy after the menopause, it is only natural to suppose that a similar result may follow the induction of an artificial menopause. Another disadvantage of oophorectomy is that the patient is left with a tumour which, diminishing in size slowly, may have time to exercise injurious pressure on neighbouring organs. It seems reasonable, moreover, to suppose that a patient with both her ovaries, and without a uterus, is in a better position than one possessing a uterus enlarged by fibroids and no ovaries ; and such evidence as we possess at present points to the justice of this conclusion.

Removal of the ovaries is by no means an easy operation in all cases. When the tumour is large the operator will find it often difficult, and occasionally impossible, to remove the ovaries, more especially when the tumour grows into the broad ligament.

Such conditions as were formerly considered to influence us in the choice of oophorectomy rather than hysterectomy, as general condition of the patient and a tumour, the situation of which was supposed to cause unusual risks, do not now have the same weight. If a patient's condition will allow of oophorectomy, it may be taken that hysterectomy can be performed. And as regards the situation of the tumour, the occasions on which the difficulties attendant on this cannot be overcome by the surgeon accustomed to pelvic surgery must be extremely rare.

(3) **Dysmenorrhœa and various Neuroses.** Oophorectomy for dysmenorrhœa has been attended by such disappointing results that the greatest hesitation should be adopted in suggesting its performance or carrying it out. Practically the only cases in which removal of the ovaries for severe menstrual pain should be entertained are those in which the pain may reasonably be ascribed to some lesion affecting these organs. In some of these cases the ovaries are the seat of chronic ovaritis, occasionally accompanied by definite inflammation of the tubes. When with such a condition the patient has intolerable monthly pain, which has resisted all attempts at treatment by rest and drugs, and when, as Dr. Griffiths points out,[1] the suffering is not out of all proportion to the ascertained lesions, removal of the inflamed ovaries will have to be considered. Whilst this operation may relieve the local symptoms, the general nervous symptoms from which these patients suffer very often persist, or become intensified and may prove as grave a source of trouble as the original pain. A very necessary note of warning has been sounded by Mr. Bland Sutton, Dr. Horward Kelly, and others, with regard to the diagnosis of oophoritis. The ovary may normally

[1] *Syst. Gyn.*, Allbutt and Playfair, p. 864.

contain large Graafian follicles, and the presence of these does not constitute oophoritis. A cystic ovary, the result of inflammation, is considerably larger than normal, with a thickened tunica albuginea, and a stroma that is more fibrous and denser than normal. With regard to other neuroses, such as hysteria, epilepsy, and insanity, experience has shown us that the removal of the ovaries for these conditions is not justified by the results obtained. On this subject Mr. Bland Sutton's remarks are worth careful attention : " The removal of the ovaries and tubes has been recommended and practised for the relief of such conditions as (1) epilepsy and insanity ; (2) dysmenorrhœa ; (3) ovarian neuralgia. In this group the procedure has not been followed by encouraging results ; indeed, they are so unsatisfactory, that those who have had the greatest experience in this class of surgery are almost unanimous in condemning the operation, save under very exceptional conditions : even then the operator should safeguard himself by seeking confirmatory opinion. The chief objections are summarised in the following clauses : (1) In a very large proportion of cases the removal of the ovaries and tubes fails to relieve the patient. (2) In many cases the operation aggravates the symptoms. (3) Many cases, reported a few weeks or months after the operation, have subsequently relapsed. . . . In many instances where oophorectomy has been carried out for relief of pain, unaccompanied by objective signs in the pelvic viscera, the operators have pointed out, in justification of the interference, that the ovaries were cystic. . . . Such men, . . . when they excise an ovary for pain, cut into the organ, and, finding ripe follicles, describe it as a cystic ovary. Every normal ovary is cystic ; hence an excuse is readily found." Even when some definite lesion exists the results have not proved satisfactory. Writing of epilepsy, Dr. Weir Mitchell [1] says : " In no case seen by me had ablation of the ovaries and termination of menstruation cured epilepsy. I have never sanctioned such operations where the appendages were sound. I have agreed thrice to these operations in epilepsy with such pelvic disease as of itself would justify oophorectomy. In all three, after some delay, the fits returned, and were in no way permanently aided."

(4) **Osteomalacia.** The removal of the ovaries in the treatment of this disease has been performed a number of times since it was suggested by Professor Fehling, of Eâle, in 1887, and appears to have met with signal success, the course of the disease being arrested and the patients restored to active life.[2]

THE OPERATION

(1) **When Appendages are not Inflamed or Adherent.** The preparation of the patient, operating-room, &c., is similar to that already described for ovariotomy. An incision of about three inches is made in the median line, and carried down to within an inch of the pubes. The different structures of the abdominal wall are divided until the peritoneum is reached. This is then picked up by a pair of forceps, and, care being taken that intestine is not included in the grasp of the forceps, is divided horizontally. The peritoneum is then incised for the length of the incision on two fingers used as a director. Two fingers are now

[1] Quoted by Dr. H. Kelly, *loc. cit.*, vol. ii, p. 194.
[2] Bland Sutton, *loc. supra cit.*, p. 384.

inserted into the abdominal cavity, and seek the fundus uteri. From this starting-point they are passed along one or other broad ligament and seize the corresponding Fallopian tube and ovary, which are then drawn out of the wound. With a blunt pedicle needle a double ligature is passed through the broad ligament, and the loop of the ligature being divided, the two strands are interlocked. One ligature is carried round the tube close to its uterine attachment and tied firmly, and the other one is tied over the free edge of the broad ligament. Whilst the ligatures are being tightened the traction on the appendages should be relaxed.

It has been objected to this mode of tying the broad ligament that it puts tension on it, and drags together its pelvic and uterine ends, so leading to the risk of the ligature slipping, with consequent hæmorrhage. Dr. H. Kelly [1] therefore recommends that the uterine and ovarian vessels should be tied separately. "The first ligature includes the ovarian veins and artery, and is passed through the clear space in the broad ligament and tied near the pelvic brim over the top of the infundibulo-pelvic ligament, well beyond the fimbriated end of the tube. A second ligature is applied to the utero-ovarian ligament posteriorly. A third ligature is passed over the top of the broad ligament at the cornu uteri, embracing the uterine vessels which are visible and the isthmus of the tube." Any bleeding-points in the cut edge of the broad ligament are seized with forceps and tied.

(2) **Removal of Appendages when they are Inflamed and Adherent.** This is an operation that may present many difficulties in its carrying out. Whilst the sense of touch is relied on mainly for the separation of adhesions, the operation will be much facilitated for those who have less experience of pelvic surgery by bringing into play the sense of sight. For this purpose the patient should be placed in the Trendelenberg position, which affords a better view of the pelvic viscera.

Abdominal Incision. An incision about four inches long is made in the median line and carried well down to the pubes. The steps of this part of the operation are similar to those described in ovariotomy. On reaching the peritoneum care must be taken in opening the abdominal cavity, and the operator should bear in mind the possibility of adhesions existing between the omentum or intestines and the wall. The peritoneum is picked up and rolled between the finger and thumb, and, the absence of adhesions being noted, is incised, when the viscera at once fall away from the parietes. Omentum or intestines found adherent to the abdominal wall must be carefully separated by means of the fingers.

Adhesions. The condition existing should then be carefully ascertained, and the first thing likely to demand attention is adherent omentum. This is frequently found covering in and adherent to the pelvic viscera, and it may also be much thickened by inflammation. It should be freed carefully from its attachments to the pelvic organs with the fingers, care being taken not to injure intestines or bladder. Any bleeding-points should be at once secured. If much difficulty exists in freeing the omentum or in determining its exact relationship to other parts, it had better be ligatured and divided, the lower attached portion being dealt with later. In any case it is better to ligature and remove portions of omentum much thickened by inflammatory changes. If intestines are adherent they must be separated with great care, and it is in this

[1] *Oper. Gyn.*, vol. ii, p. 198.

stage of the operation that the Trendelenberg posture will be found of great assistance. The bowel, more especially after the separation of firm adhesions, should be carefully inspected, and any damage to the walls at once repaired. All adhesions existing between the intestines and omentum on the one hand, and the pelvic viscera on the other, having been freed, the abdominal organs are pushed back towards the diaphragm and maintained in position with a gauze pad. There may be some difficulty in doing so if the abdominal walls are rigid and the patient not fully under the anæsthetic. A little patience, however, will, as a rule, allow of the viscera being pushed up out of the way, so as to enable the operator to obtain a view of the pelvic contents.

Enucleation of Appendages. The operator is now in a position to set about freeing the adherent appendages. As far as is possible the condition present is ascertained by sense of sight as well as that of touch, the position of the uterus located, and the extent and fixity of the mass, formed by one or both appendages, noted. The matted tube and ovary form a tumour lying to the back of the uterus and broad ligament in the lateral fossa or Douglas's pouch, and the broad ligament is drawn over the front of the mass. The first step in enucleation is the separation of the mass from its posterior connections and from the opposite appendages, if inflamed. To effect this, the hand, with the palmar surface forward, is passed down in the hollow of the sacrum behind the mass, carefully separating with the tips of the fingers the adhesions that fix it in this situation. Working down in this way, the lower part of the mass is reached. The next step is its separation from the back of the broad ligament to which it is fixed, and which effectually prevents the tube being drawn up into the wound. Enucleation is consequently continued from below upwards with the tips of the fingers inserted between the mass and the back of the broad ligament. In this way it is gradually freed from all its connections.

Removal of Diseased Parts. The affected parts are now drawn well up through the abdominal incision, and a suitable point in the broad ligament chosen for transfixion. A blunt pedicle needle with a double ligature is then passed through the broad ligament, and the loop divided. The two strands are interlocked where they pass through the broad ligament to prevent the tearing apart of this structure, when they are tied. Each ligature is then tied separately, one round the Fallopian tube close to the uterine cornu, the other round the free upper border of the broad ligament, and, a pair of forceps being applied to the tube just beyond the ligature, the diseased parts are cut away. Where there is likely to be any tension after ligaturing the broad ligament in this way, the method described above of securing the vessels separately had better be employed, as considerable risk exists of the ligatures slipping.

The cut end of the tube held in the forceps is next brought into view and carefully wiped with 1-1000 perchloride of mercury solution, to obviate the risk of subsequent infection from the cut end. Before allowing the stump to fall back into the pelvis, the parts are carefully examined for bleeding-points, which should be seized with forceps or else underrun. Care should be exercised in the application of forceps in the pelvis lest a portion of the rectal wall be nipped, and its vitality so affected that it subsequently sloughs.

Treatment of Tube when Distended. If the tube is found to be distended with pus or other fluid, it is better, if possible, to remove it

without previously emptying it. This is recommended on account of the greater ease of dealing with a distended tube than one empty and collapsed. Greater care must, however, be exercised in the separation of adhesions, and the parts packed round with gauze or sponges to prevent, as far as possible, the spread of infective material if the tube ruptures, as it may very possibly do in the course of manipulation. Should rupture occur, the fluid must be removed as rapidly as possible, all infected sponges and swabs taken away, and the parts thoroughly cleansed.

Hæmorrhage. Oozing from large raw surfaces is sometimes free, but generally yields to pressure exercised by sponges in the course of the operation. Should it still persist, and no obvious bleeding-point be visible at the end of the operation, the pelvis should be packed firmly with strips of gauze, the ends of which are left out of the lower part of the abdominal incision or carried through an opening in the vaginal vault. The strips should be removed at the end of twenty-four hours.

Drainage will be called for more often in the case of pelvic inflammation than of ovarian tumours. The following may be regarded as indications for its employment :

(1) When, in the course of removal, a pyo-salpinx, or abscess-cavity, has ruptured and soiled surrounding parts.

(2) When the bowel has been injured in the course of the operation. Damage to the small intestine can generally be repaired without risk of subsequent leakage. Injury to the rectum cannot be so readily dealt with, and it may be impossible for the operator to gain such access to the damaged parts as will enable him to repair the lesion. To prevent general infection of the peritoneal cavity, as the result of leakage from the bowel, he will have to depend on careful gauze packing.

(3) When the operation is incomplete. Firmness of adhesions and danger of injury to viscera will sometimes lead the surgeon to leave his operation unfinished rather than subject his patient to unusual risk. He has probably exposed, in the course of his manipulations, infected areas, such as a pyo-salpinx or a pelvic abscess. Under these circumstances he will remove such diseased structures as is found possible, and provide free drainage by means of gauze strips for the infected parts left behind.

Conservative Surgery. By this term is meant the preservation of such organs or parts of organs as are not diseased or not beyond the power of recovery. This, which is the general principle underlying all true surgery, receives special significance in its application to the pelvic organs on account of the importance of the latter in securing the happiness and well-being of the individual. This applies more especially to the ovaries, which are not only essential to the functions of menstruation and child-bearing, but which exercise—probably by means of some internal secretion—a wide influence over nutritive processes in general. That every effort should be made to preserve a portion at least of one of these organs is not disputed at the present time ; the only question is how far one is justified by one's attempts at conservatism in subjecting the patient to increased risks of recurrence of disease and further operation.

An important step was made in conservative surgery when it was recognised that disease limited to the appendages of one side did not necessarily mean the removal of the organs on both. A further advance

was marked by the recognition that certain conditions, which at one time were thought to be pathological, were not diseases at all.

The cystic ovary is a case in point. Though a definite pathological condition does exist in which the ovary is the seat of numerous small cysts, the mere presence of these does not necessarily constitute an abnormal state of the organ, nor do they justify its removal.

A further reason advanced for the practice of conservatism lies in the fact that portions of organs left behind are capable of performing the functions of the entire organ. It has been shown clinically that the stump of an amputated tube may convey an ovum to the uterus, which will then pass through the developmental changes of normal pregnancy.[1]

Dr. Kelly[2] has recorded a case in which pregnancy followed an operation involving the removal of one tube and the opposite ovary, and where the transmission of the ovum was effected by the tube on the side opposite to that of the ovary. Similar cases have been recorded in which pregnancy has followed operations involving partial removal of the appendages. Whilst such an event may not be very common, the mere fact that it can occur constitutes a further reason for exercising such conservatism as is possible in dealing with the pelvic organs.

The capacity for repair shown by inflamed pelvic organs and the powers of absorption of the peritoneal sac in the case of large inflammatory exudates are well-established facts. A similar course of events is known to all surgeons in the case of the vermiform appendix. This power of regeneration is a point telling in two ways, for whilst it will encourage the operator to sacrifice as little as possible of the organs he is dealing with, it is also an argument in favour of rest and expectant treatment.

There are certain conditions other than disease of the tubes and ovaries demanding operation in which there can be no doubt as to the advisability of leaving the ovaries or as much of them as can be safely preserved. Hysterectomy for fibroids is a case in point, where one or both ovaries should be left when possible. A further example is seen in parovarian cysts, which may be shelled out sometimes from the broad ligament without sacrificing tube or ovary.

When we come to disease of the ovary itself, it is especially in non-inflammatory affections that an attempt may be made to save a portion of the organ. Such conditions as cysts due to enlargement of Graafian follicles or corpora lutea may be dealt with on this principle, the cyst being shelled out or a wedge-shaped portion of the ovary being removed. In the case of dermoids and the cystomata the ovarian tissue is, as a rule, so involved that an attempt to save a part of it will not often be found possible. Even when, as occasionally happens, some of the ovarian tissue remains unaffected, the advisability of trying to preserve it is open to question on account of the risk of leaving behind sufficient of the tumour to lead to a recurrence. Nor does it seem improbable that the remaining portion of the ovary is liable to a similar cystic change. The chief justification for saving a part of the organ would be in the fact that the opposite ovary either required removal or had already been removed.

It is in dealing with inflammatory conditions of the appendages that

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[1] B. F. Baer, *Ann. of Gyn. and Ped.*, January 1894.
[2] *Loc. cit.*, p. 188.

the widest difference of opinion with regard to conservatism exists.   It was the practice at one time, if the appendages on one side were diseased, to remove those on the other side, even if found healthy.   This was done more especially in those cases in which the tubes were the seat of suppuration.   The late Mr. Greig Smith [1] said : " The removal of the appendages on one side only for suppurative disease was tried by Tait, but given up on account of the large number of recurrences or relapses.   Other surgeons have had similar experiences ; and the rule in all cases of suppurative diseases of the appendages now is that if one set is removed, so also should be the other."

In spite of the risks of recurrence, modern opinion inclines strongly to the preservation of healthy appendages, and, as the interior of the uterus is the source of infection in most cases, the more rational treatment is to attend carefully to this, and thus prevent the extension of inflammation, so far as is possible, to the sound appendages.   Before deciding to leave them they should be carefully examined.   Should pus be found to exude from the end of the tube, it should be removed.   Such a high authority as Dr. Howard Kelly [2] recommends that under certain circumstances the contents of the tube should be squeezed out and its interior washed out with saline solution, and then sterilised with 1 in 5000 corrosive sublimate solution.   It is difficult to believe that the tube can be effectually sterilised in this way, and its preservation would seem to invite reinfection of the peritoneal cavity.   Until more evidence is forthcoming with regard to this procedure it appears unsafe to recommend it for general adoption.   On the subject of adhesions Dr. Kelly has laid it down as a rule that these do not in themselves constitute a reason for the removal of organs.   The mere presence of adhesions does not imply that the organs are beyond the power of recovery, and, in fact, there is plenty of clinical evidence to the contrary.   It has already been mentioned that in some cases the persistence of symptoms is due rather to adhesions binding down the pelvic organs in abnormal positions than to the presence of any source of inflammation.   Under these circumstances, operative proceedings may be limited to the separation of adhesions and the fixation of organs in better position.   Dr. Kelly has laid stress on the importance of not only freeing the organs from surrounding parts, but also of liberating any kinks in the tube, a condition that may render the patient liable to tubal pregnancy.

Whilst treatment limited to the freeing of organs may be followed in those cases in which the inflammation has subsided, it should not be adopted when they are still inflamed.   The separation of adhesions without removal of the cause is certain to be followed by the formation of fresh ones, besides breaking down the barrier that limits the spread of infection.

The question may arise as to whether the Fallopian tube should be preserved when removal of the corresponding ovary is found necessary.

In inflammatory conditions of the appendages, it is uncommon to find a case in which the ovary requires removal and the tube is found in a healthy state.   Moreover, the tube is useless without the ovary, and as the late Mr. Greig Smith has pointed out, the removal of the latter will probably cause kinking of the tube.   Consequently, if the ovary is removed, it is usually safer to remove the tube also.[3]   It might be left

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[1] *Syst. of Gyn.*, Allbutt and Playfair, 1896, p. 910.
[2] *Loc. cit.*, vol. ii, p. 186.   [3] *Loc. supra cit.*, p. 909.

if operative measures have resulted in the preservation of the opposite ovary, but removal of the corresponding tube. In Dr. Kelly's case, quoted above, pregnancy followed such an operation, leaving one ovary and the opposite tube.

Those conditions have been pointed out in which the practice of conservative surgery may be safely advised. But there are certain operations more open to debate, such as the washing out of tubes containing pus, the amputation or resection of diseased tubes, and the opening of closed tubes. In the hands of the chief advocates of conservatism these procedures have met with results that may be regarded as encouraging, but, with our present information, they are not operations that can be recommended for general adoption.

OPERATIONS ON THE UTERUS

REMOVAL OF MYOMATOUS UTERUS BY ABDOMINAL SECTION: CANCER OF THE UTERUS. REMOVAL OF A CANCEROUS UTERUS BY ABDOMINAL SECTION. REMOVAL OF A CANCEROUS UTERUS PER VAGINAM. CÆSARIAN SECTION. PORRO'S OPERATION. ECTOPIC GESTATION

REMOVAL OF MYOMATOUS UTERUS BY ABDOMINAL SECTION

Indications for Operation. A fibroid tumour of the uterus does not by its presence merely afford a sufficient indication for operation. It must either give rise to symptoms, which threaten life, or be a source of such discomfort from its size or position as to prevent a patient enjoying a reasonably comfortable existence or earning a livelihood. The following is a list of indications that justify removal of a myomatous uterus :

(1) **Hæmorrhage.** Profuse hæmorrhage at the menstrual period is the symptom that is the commonest, and that most often necessitates a patient seeking advice. The amount lost, and its effect on the patient's health, the influence of drugs and general treatment, the age of the patient, are all factors to be taken into consideration. In women about 40 years of age the operation is often deferred in the hope that the menopause will cause not only a cessation of bleeding, but will lead to a shrinking of the tumour. The fact that the climacteric is generally postponed, and not infrequently deferred till after fifty years of age, should be remembered, and if the hæmorrhage is very profuse, leading to profound anæmia, and very little relief is afforded by milder measures of treatment, the advisability of a radical operation should be put before the patient.

(2) **Pressure Symptoms.** These are most marked in the case of medium-sized tumours impacted in the pelvis. The most common symptom is frequent or difficult micturition. There may also be trouble in keeping the bowels open, owing to pressure on the rectum. The ureters may be pressed on, and hydro-nephrosis or pyelo-nephritis result. These symptoms are most marked just before the onset of the menstrual flow, when the tumour is swollen as a consequence of the natural engorgement of the organs.

Pain in association with fibroids is due not only to pressure on nerves and neighbouring organs, but also to attacks of peritonitis and inflammation of appendages. Dr. Kelly draws special " attention to the fact that those myomata which are constantly associated with great pain

almost invariably belong to the class of complicated cases in which a tubal or ovarian inflammatory disease will also be found ." [1]

(3) **Great Size.** A large tumour in the abdomen may not necessarily threaten life, but may be a source of grave inconvenience and discomfort. It interferes with the return of blood from the lower limbs, and so causes œdema ; it presses on the stomach and impedes digestion ; it limits the movements of the diaphragm, and so interferes with respiration ; and, by preventing an active existence, leads to a condition of general ill-health. As Mr. Herman [2] points out, " these consequences of great bulk not only call for operative cure ; unfortunately they do more : they add to its risk. . . . In the present state of abdominal surgery,
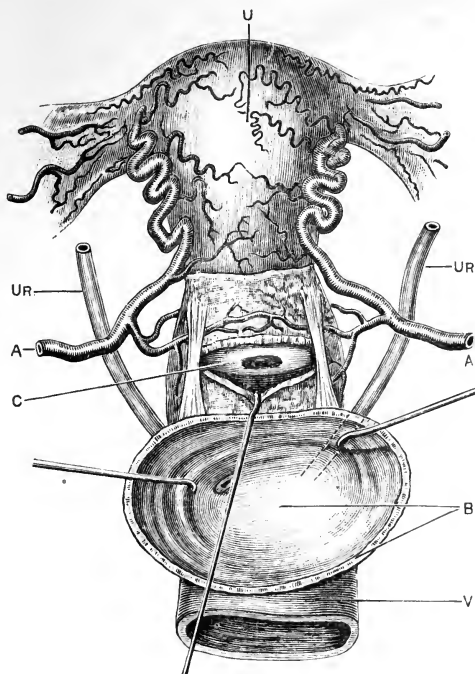
Fig. 365. Relation of the ureters and uterine arteries to the cervix. (Baldy.)

U, Uterus.	C, Cervix.
Ur, Ureter.	V, Vagina.
A, Uterine artery.	B, Section of bladder.

the risk to life in the removal even of a big fibroid is small, and the possible undesirable after-consequences are less grave than the constant presence of a great tumour. A well-advised patient will, therefore, welcome relief by operation."

(4) **Rapid Growth of the Tumour.** If at intervals of a few months the tumour is found to be markedly increasing in size, the question of its removal will have to be considered. Very rapid enlargement is usually due to secondary changes occurring in it, such as œdema, or cystic degeneration. A sarcomatous change will also be responsible for a rapid growth, but is of rare occurrence.

[1] *Loc. cit.*, vol. ii, p. 367. [1] *Loc. supra cit.*, p. 822.

(5) **Complications** due to associated inflammatory disease of the appendages and peritoneum, tumours of the ovary, cancer of the uterus —will call for operative interference.

There are two methods employed in the removal of a myomatous uterus, in one of which the hysterectomy is partial, in the other total. They are respectively :

(i) Supravaginal hysterectomy.

(ii) Total hysterectomy.

(i) **Supravaginal Hysterectomy.** The mode of operation described is, in its essentials, that associated with the name of Dr. Baer,[1] of Philadelphia. The principles on which he based his operation were—" first,
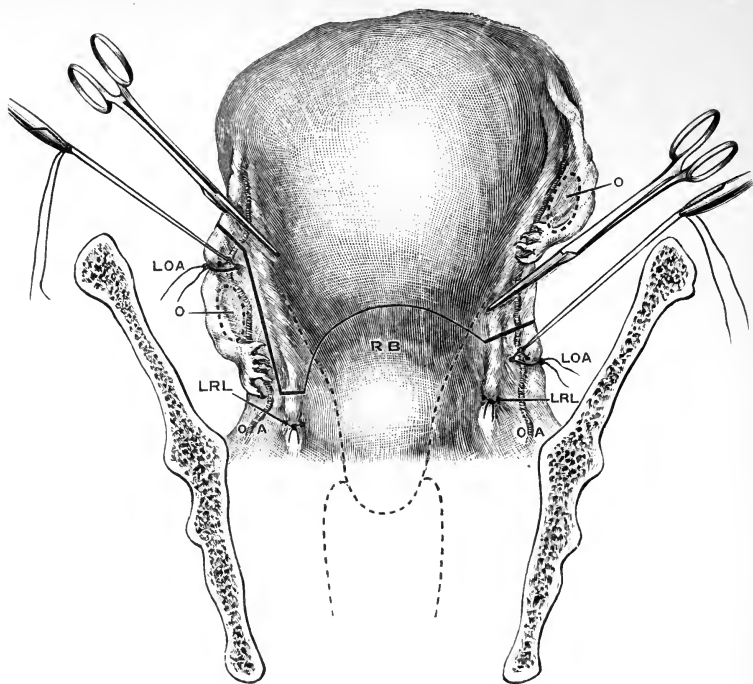
Fig. 366. Operation of supravaginal hysterectomy seen from the front.
First stage. (Galabin.)

A double ligature is placed on both ovarian arteries, and a single ligature on both round ligaments. The thick black line indicates the line of incision through the broad ligaments ; the thin black line, the line of division of the anterior peritoneum ; LOA, ligature on ovarian artery ; LRL, ligature on round ligament ; O, ovary ; OA, ovarian artery ; RB, reflection of bladder.

control of hæmorrhage by ligature of the blood-vessels in the broad ligaments ; second, non-constriction of the cervical tissues, so that there shall be no cause of suppuration ; and third, non-disturbance of the cervical canal, so that sepsis from the vagina may be prevented." Dr. Kelly [2] draws attention to the fact that the very important step of systematically securing the ovarian and uterine arteries in their course, as a preliminary to hysterectomy, was devised by Dr. L. A. Stimson, of New York.

[1] This method of operation was published in the *Transactions of the American Gynæcological Society*, vol. xvii (1892), p. 234, and vol. xviii, p. 62.
[2] *Loc. supra cit.*, p. 365.

The Operation. The patient having been prepared, an incision is made in the median line, proportionate to the size of the tumour to be removed. It should be carried well down to the pubes, as by this means the subsequent steps in the operation are facilitated, and if necessary continued upwards to the left of the umbilicus. Care should be taken in dividing the peritoneum not to injure the bladder which is occasionally drawn up by the tumour. A hand is now introduced into the abdomen, and the condition present carefully examined. Adhesions on the front of the tumour are very rarely met with. When they exist they will be found behind, and are almost invariably the result of salpingitis. If the uterus is large and the adhesions are dense, more particularly when a pyosalpinx of long standing exists, the difficulties of the operation are likely to be considerably increased. All adhesions must be broken down and the tubes freed before the removal of the uterus can be carried out. In the simpler cases the tumour is brought out of the wound, but when this cannot be done, it will be necessary to carry out the earlier stages of the operation with the uterus in the abdomen.

Division of Broad Ligaments. The uterus having been drawn out of the abdomen, the operator carefully examines the broad ligaments and appendages on each side, and decides whether he will leave one or both ovaries, or whether he will remove them both. When possible, one at least should be saved, exception being made in those cases in which they are found diseased, or when it is found impossible to leave them, or the patient has reached the menopause. The surgeon, after carefully examining both sides, chooses that which can most easily be dealt with, and, seizing the upper part of the broad ligament, passes through it, at a point free from vessels, a blunt pedicle-needle threaded with silk or catgut. The exact point of perforation will depend upon whether the ovary is to be removed or not ; in the former case the ligature will be carried round the free edge of the broad ligament ; in the latter it will include the Fallopian tube.

This ligature, which secures the ovarian artery, is then firmly tied, and that portion of the broad ligament next the tumour being secured by means of forceps, the part intervening between the ligature and the forceps is divided (Fig. 366). A second ligature is passed through the broad ligament of the same side, lower down, including the round ligament, and firmly tied ; the proximal portion of the broad ligament is clamped, and the part between forceps and ligature divided. In most cases these two ligatures will be found sufficient, but more can be applied in the same way if required. The use of forceps for clamping the proximal part of the ligament, as described above, rather than ligatures, will be found to effect a saving of time. The opposite side is then dealt with in the same way.

Formation of Anterior Flap. The next step in the operation is the reflection of a flap of peritoneum and the bladder from the front of the uterus. An incision is made through the peritoneum covering the front of the uterus, from side to side, about an inch above the line of attachment of the bladder, the position of which should be carefully ascertained. It should be carried across to join at each extremity the lower end of the cuts in the broad ligaments. The bladder is then separated from the uterus by means of the finger, any firmer bands (and these are met with especially in the median line) being divided with scissors. Care should be taken in this separation, as the bladder

is sometimes much thinned by stretching, and it does not require much force to push the finger through into its interior. Should this accident happen, the opening must at once be closed with sutures. By the reflection of the anterior flap some loose cellular tissue on each side of the neck of the myomatous uterus is exposed, and in this there may be felt pulsating, and sometimes seen, the uterine artery.

Ligature of Uterine Atery. The position of the artery is now carefully defined on one side, and a ligature threaded on a pedicle-needle is passed through the cellular tissue between the artery and the uterus, and just below the point at which the division through the uterus is to effected. A pair of Spencer-Wells forceps are now applied so as to
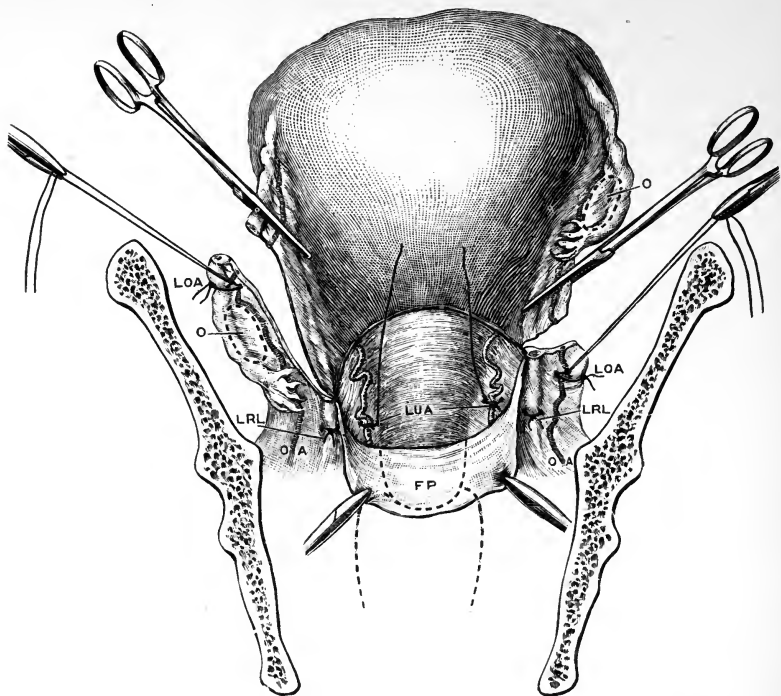
FIG. 367.   Operation of supravaginal hysterectomy seen from the front.
Second stage.   (Galabin.)

The outer part of the broad ligament is divided on each side. The anterior peritoneal flap is stripped down and held by two pressure forceps. One ligature is placed on each uterine artery. A second ligature is passed through the broad ligament just within it, ready for subsequent use. LOA, ligature on ovarian artery; LRL, ligature on round ligament; LUA, ligature on uterine artery; O, ovary; OA, ovarian artery; FP, anterior flap of peritoneum.

include the artery a little above the ligature, and the latter is firmly tied. The tissues, including the uterine artery, are then divided between the ligature below and the forceps above, and if the ligature has been properly applied there will be no bleeding. If the artery has not been secured it will spurt on division, and should be promptly seized with forceps and tied. The same procedure is adopted on the opposite side. It may happen that in the passage of the pedicle needle round the uterine artery, hæmorrhage at times so free as to be alarming results. This is due to injury to veins which may be of great size. The best way of

avoiding this is to carry the ligature as close as possible to the uterus. When it occurs, clamp at once the uterine vessels above the ligature, where they lie close against the uterine wall. If the bleeding is taking place from the veins returning from the tumour it will be arrested by these means. If it continues and the vessel cannot be seen, get an assistant to press with a plug in the neighbourhood of the bleeding, to control it if possible, quickly clamp or ligature the uterine vessels on each side, cut through the cervix and remove the tumour, and then search for the bleeding vessel. It will often be found on removal of the uterus that the bleeding has ceased, showing that the hæmorrhage was coming from the tumour.

Removal of Uterus. A point has now been reached at which the blood-supply has been secured, and nothing is left keeping the enlarged
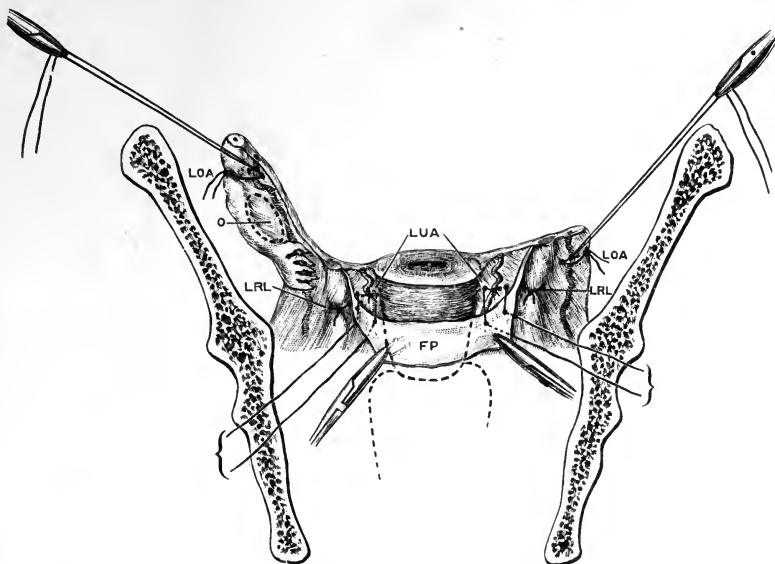
Fig. 368. Supravaginal hysterectomy seen from the front. Third stage.

The uterus has been cut away. The ligature on each side, for stitching the anterior peritoneal flap over the uterine artery, is passed and ready for tying. LOA, ligature on ovarian artery; LRL, ligature on round ligament; LUA, ligature on uterine artery; O, ovary; F P, anterior flap of peritoneum.

uterus in position but the narrow neck below. The only remaining step is to divide this latter. The intestines being kept out of the way, the left hand is passed down behind the neck to prevent the possibility of injury to bowel, and the pedicle is divided with knife or scissors just above the point at which the uterine arteries are secured.

The division of the pedicle is effected in various ways. The simplest method is to make an incision straight through, so as to leave a flat raw surface, which is subsequently covered in by the peritoneal flaps. Dr. Baer, in his original description [1] considered that in most cases it was sufficient to allow the flaps to fall together over the stump, and that there was no need to suture them. To render the stump completely extraperitoneal it is better, however accurately to coapt the cut

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[1] *Loc. supra cit.*

edges of the peritoneum. This is effected by means of a continuous catgut suture. The divided edges of the broad ligament on one side are first sewn together. The anterior flap of peritoneum is then drawn over the stump, and its free border sutured to the cut edge of peritoneum at the back of the stump, the operation being completed by sewing together the two edges of the remaining broad ligament. In defining the principles on which this operation was based, Dr. Baer laid stress on the importance of not disturbing the plug of mucus in the cervical canal as he regarded this as a bar to the spread of infection. Though in healthy women the interior of the uterus appears to be free from organisms, in
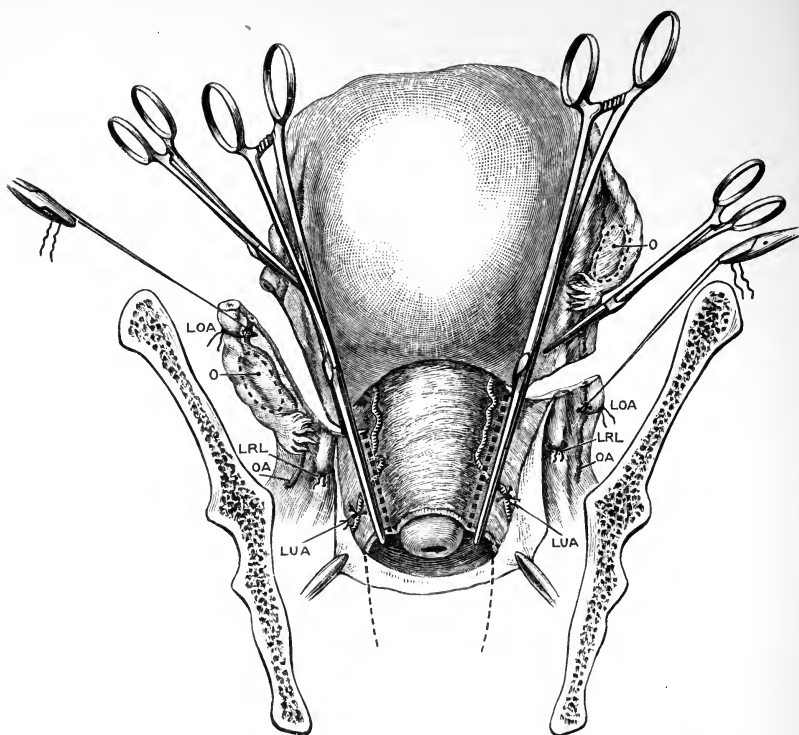
Fig. 369.   Abdominal panhysterectomy seen from the front.   Final stage.
(Galabin.)

The uterine arteries have been tied, and thin clamps placed upon the remaining parts of the broad ligaments, posterior and anterior vaginal fornices being opened. The dotted lines show the lines of incision to separate the uterus. LOA, ligature on ovarian artery ; LRL, ligature on round ligament ; LUA, ligature on uterine artery ; o, ovary ; OA, ovarian artery.

some cases of fibroids this is not the case, and one objection made to the simple division of the cervix is that infection of the wound may take place from the cervical canal. On this account I prefer to close the canal. This may be effected by making the incision through the cervix V-shaped, and approximating closely the two flaps by catgut sutures. The cut edges of the broad ligaments on each side are then brought together by a continuous catgut suture and the anterior flaps of peritoneum sutured over the cervix to the peritoneum on its posterior aspect.

Some Difficulties met with in Hysterectomy of Fibroids. Although the operation for a myomatous uterus as described above may be straight-forward and comparatively easy, cases are frequently met with which will tax the resources of the surgeon. Few operations call for greater variety of treatment depending upon the variations in the size and situation of the tumours. A large tumour is not necessarily difficult to remove, a smaller one may present considerable difficulties. It may be said roughly that the ease of the operation will depend upon the facility with which the myomatous uterus can be drawn up out of the pelvis, and the uterine vessels reached.

One form of difficulty not infrequently met with is due to a fibro-myoma growing to one side between the layers of the broad ligament, expanding this together with the Fallopian tube and ovary over its surface. It may even spread out the mesosigmoid, so that the bowel is closely applied to its surface. Such a tumour cannot be drawn up out of the pelvis. The Fallopian tube and round ligament having been picked up, ligatured and divided, the opening thus made in the peritoneum is sufficiently enlarged to allow of the tumour being shelled out. The peritoneum may contain large veins and care should be taken not to injure them, ligatures or clamps being used as required. A careful watch should also be kept for the ureter which may be much displaced. The tumour may then be drawn up and a search made for the uterine vessels. If the fibroid cannot be drawn up, the procedure adopted by Dr. Howard Kelly may be followed. Instead of tying and dividing the broad ligaments on both sides before severing the pedicle, he works across the pelvis from one side to the other, dividing first one broad ligament, then the pedicle, and dealing last of all with the other broad ligament. The stages of the operation as described by him are shortly as follows : [1]

(*a*) **Ligation of the Ovarian Vessels and Round Ligament of one side, usually the left.** In a woman under forty years of age he considers it better to leave both ovaries in the pelvis, with or without the uterine tubes. The broad ligament is divided between two sets of ligatures, or between forceps on the proximal and ligatures on the distal side, as previously described.

(*b*) **Detachment of the Vesico-uterine Fold of Peritoneum.** The uterus being drawn back, " the anterior loose peritoneal fold along the curved line of the utero-vesical reflection is cut through from round ligament to round ligament. As the bladder is raised, the loose cellular tissue beneath it is exposed, and it may be still further freed by a rapid dissection with knife or scissors." The separation of the bladder is completed by pushing it well down with a sponge firmly compressed in sponge-forceps, until the cervix is bared almost quite down to the vaginal junction.

(*c*) **Ligation of the Uterine Vessels of the same side.** These vessels are now securely tied close to the cervix by a silk ligature on a curved needle passed close to the cervical tissue, but not entering it.

(*d*) **Amputation of Uterus in Cervical Portion.** The uterus is now drawn to the other side, and the uterine vessels are divided from 6-10 mm. above the ligature, an assistant being ready with artery-forceps to grasp any bleeding vessel left by chance out of the ligature. The uterus is now completely divided in its cervical portion, at a point just above the vaginal

[1] *Loc supra cit.*, p. 368.

junction, and in such a way as to leave a cup-shaped pedicle. It is a good plan, when the cervix is nearly divided, to cut upward for one or two centimetres so as to leave behind a thin shell of cervical tissue, and expose the opposite uterine vessels at a higher level, when it is much easier to tie them without risk of including the ureter.

(e) **Clamping the Uterine Vessels of opposite side, the Round Ligament, and the Ovarian Vessels, followed by Removal of the Tumour.** As the uterus is drawn up and rolled over on to its side, the uterine vessels come into view; these are seized in clamp forceps and divided. The uterus is rolled over still more till the round ligament is seen. This is
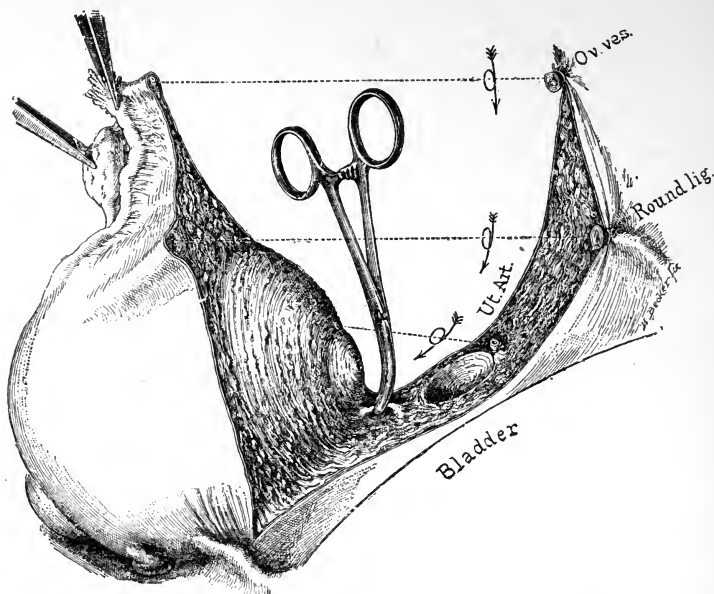
FIG. 370. The operation of hystero-myomectomy. (Kelly.)

By a continuous incision from left to right, ligating or clamping—at the points indicated by the arrows—first the left ovarian vessels (Ov. ves.), next the round ligament, and then the left uterine artery (Ut. Art.). Finally, the cervix is cut across, and the uterus pulled away until the right uterine vessels are exposed.

clamped and divided, and is followed by similar treatment of the ovarian vessels. The whole mass is thus freed and taken away.

(f) **Application of Ligatures in place of Forceps.** The parts now held in forceps (the ovarian vessels, the round ligament, and the uterine vessels) are successively tied with firm silk ligatures and the forceps removed.

(g) **Suturing the Cervical Stump.** The stump is carefully examined for any bleeding-points, which should be tied. It is now closed over the cervical canal by passing from three to five or more catgut sutures in an antero-posterior direction, and tying each one as it is passed. By suturing in this way the cup-shaped pedicle is changed into a transverse linear wound. Should there be a discharge of pus from the uterus or a muco-purulent plug in the canal, this latter should be wiped out with gauze as soon as cut across, and afterwards dissected out with a sharp knife and forceps.

(*h*) **Covering the Wound-area with Peritoneum.** The large flap of peritoneum which lies in front of the pedicle is drawn over the stump and sutured to the posterior peritoneum by a continuous suture.

This method can be varied to suit the different conditions associated with fibromyomata growing out into the broad ligament and meso-sigmoid. The bowel can usually be separated without difficulty. I have only had one case in which it was intimately attached to the tumour, and in that case extensive degeneration had taken place so that the tumour was a thin shell containing a fluid yellow detritus.

A tumour growing forward between the cervix and bladder may effectually prevent the uterine vessels from being approached. In this case, it must be shelled out from the uterine wall. Cut well down to the tumour through the layer of uterine muscle covering it before attempting to remove it. This may be associated with much bleeding and should in that case be carried out quickly. This method of shelling a tumour out of its capsule may be followed with advantage in other situations in which a fibroid is so placed as to interfere with the progress of the operation.

When a large tumour is situated behind the uterus and below the peritonuem, such for example as a fibro-myoma in the posterior lip of the cervix, instead of attempting first to remove it or to separate it from its connections, it will be found better, after tying the vessels and dividing the broad ligaments, to cut through the cervix from before backwards in the usual way. All that remains then is to shell out the tumour from the pelvic floor.

(ii) **Total Hysterectomy.** As a routine operation for fibroids, complete removal of the uterus is not to be recommended. It prolongs the operation, and by the opening of the vagina increases the risks of septic infection. It may be called for, though rarely in cases of fibroid tumour or fibrosis of the uterus. When undertaken it is generally for cancer of the uterus. The operation performed for cancer of the cervix is described separately. That now described is confined to the removal of the uterus, and is suitable for certain cases of carcinoma of the body, more particularly when age or infirmities render the more complete operation known as Wertheim's inadvisable. The broad ligaments having been divided and the bladder separated in front from the cervix and upper part of the vagina, the uterine arteries are sought for. In partial hysterectomy these were tied by a ligature passed as close as possible to the uterus. For the complete removal, they must be tied a sufficient distance from the uterus to allow of a pair of Spencer-Wells or clamp forceps being applied between the ligature and the uterus. The position of the ureters below the uterine vessels must be borne in mind, but the risk of including them is not great if the vessels are carefully exposed and are not tied too far out. The vessels being tied on each side and a clamp applied, the tissues between the forceps and the uterus are then divided, and a pair of forceps are applied on each side to include the remaining tissue of the parametrium as far down as the vaginal vault. This again is divided between the forceps and the cervix. The uterus now remains attached only to the vagina. The bladder being sufficiently reflected from the anterior vaginal wall, this latter is divided with scissors in front, and the incision is carried round the vaginal vault so as to detach the uterus completely. Any bleeding vessels in the cut vaginal wall are secured, and the tissues included in the forceps on each side are ligatured and the forceps removed.

The next step is to unite the cut edges of the peritoneum. An iodoform gauze plug is introduced into the vagina from above and its end cut off level with the upper edge of the vagina. With a continuous catgut suture, the cut edges of the peritoneum are then approximated. Having sewn together the two layers of the broad ligament on one side, the anterior peritoneal flap is brought over the vaginal opening and secured to the posterior cut edge of the peritoneum, the operation being completed by the closure of the broad ligament on the remaining side.

CANCER OF THE UTERUS

Carcinoma of the Cervix. For this condition, the uterus may be removed by two routes, the vaginal and the abdominal. The older form of operation by the vagina will be described first of all. Although it has been replaced to a considerable extent by the abdominal operation, it still has a considerable range of utility. Owing to the rapidity with which it can be performed, and its freedom from severe shock, it is adapted to elderly and to feeble patients.

A. **Vaginal Hysterectomy for Carcinoma of the Cervix.** *To determine whether Case is suitable for Removal of the Uterus.* It is not easy in a case of cancer of the cervix to say whether the whole disease can be eradicated, as growth may have extended beyond the limits of the uterus, and yet be inappreciable on the most careful examination.

To determine whether a case is operable, the different routes by which the growth may advance must be carefully borne in mind, and a systematic examination made of each. They are as follow :

(1) The growth may involve the fornices or extend down on to the vaginal walls.

(2) It may extend forwards and involve the bladder.

(3) It may extend outwards in the broad ligaments,

(4) Or extend backwards in the utero-sacral folds and involve the rectum.

In examining a case the first thing to be noted is the mobility of the uterus. This may be tested most efficiently by fixing a pair of tenaculum forceps into the cervix, and observing whether the organ can be drawn down readily towards the vulva. If there is complete or considerable fixation and wide extension of growth in any of the above-mentioned directions the case is inoperable, and should be left alone. The cervix should be examined, not only digitally, but through a speculum, and the extent to which the fornices or the walls of the vagina are involved carefully noted. To determine whether extension laterally in the broad ligaments or backwards in the utero-sacral folds has taken place, the vaginal examination must be supplemented by a rectal one, and a search made for any masses or thickening in these situations.

If the uterus is freely movable, and can be pulled down to the vulva, and there is nothing to be felt in the broad ligaments or utero-sacral folds, the case is a favourable one for operation, and there are good grounds for hope of permanent relief.

But between the eminently favourable cases and those that are to be regarded as inoperable certain cases are to be met with, not infrequently, in which there exists an element of doubt as to whether the growth can be entirely removed. On this point Dr. Howard Kelly's remarks are worth quoting : " In concluding whether or not to operate, the

patient should in all cases have the benefit of any reasonable doubt, and the operator must not be too exacting in restricting his indications. I have operated several times where the disease was found so advanced that there could be no reasonable question but that some portion of it was left behind, and this was confirmed by a microscopic examination of the specimen, which showed cancer cells right up to the cut edge of the broad ligament, and yet one of these patients enjoyed perfect health for five years, when the disease reappeared in the glands of the neck ; another had a local return after three years of good health, and two others are living, apparently in perfect health, three and four years after the operation." [1]

In considering this question, the influence that repeated losses of blood and continuous septic absorption from the breaking-down cancerous mass have on the health of the patient should be borne in mind. If under the circumstances there is reason to think that the uterus can be removed without unusual risk, the surgeon is justified in operating after laying the facts of the case fairly before the patient. For recurrence of the disease, so long as it does not take place in the vaginal roof, will be attended with less pain, an absence of hæmorrhage, and a relief from the distress dependent on a fœtid discharge.

No radical operation should be undertaken if extension of growth has led to involvement of bladder, ureters, or rectum.

Palliation may be afforded in some inoperable cases by a free scraping away of the growth in the cervix. Whilst considerable benefit follows in some cases, in others, and especially when the growth is very advanced, scraping has done more harm than good by hastening communication with the bladder and other organs.

Operation. There are many modifications in the various stages of this operation adopted by different surgeons, the chief of which is the treatment of the broad ligaments, some preferring to tie these with silk or catgut, others to clamp them.

Preliminary Treatment. For some days beforehand the vagina should be freely douched with some antiseptic lotion, such as 1–500 formalin.

For the operation the patient is placed in the lithotomy position, and the legs secured by means of a Clover's crutch. The perineum is retracted with a Sim's or Simon's speculum. Lateral retractors may be found useful at certain stages of the operation. The cervix is drawn down to the vulva by vulsella, one pair of forceps being applied, as a rule, to the anterior lip, one to the posterior. The point of attachment will, however, depend to some extent on the condition of the cervix. In the case of large cauliflower excrescences it will often be found necessary, as a preliminary to freeing the uterus, to remove the growth freely with scissors and sharp spoon. Some surgeons prefer, in all cases in which there is exposed cancerous growth on the cervix, to remove it before commencing the operation. This procedure is based on sound principles. In the removal of cancer elsewhere in the body, every precaution that is possible is taken against the reinfection of the wound surfaces by cancerous material. That raw surfaces may be inoculated in this way is abundantly proved by clinical and experimental evidence. Mr. Herman, amongst others, recommends that all exposed growth should be thoroughly scraped away with a sharp spoon until firm tissue is reached. A

[1] *Loc. supra cit.*, p. 319.

Paquelin cautery is then applied to the whole surface. By this means the chance of reinfection of the operation wounds is greatly minimised.[1] In Dr. Baldy's *Gynœcology* (1894, p. 389) it is further recommended that the funnel-shaped excavation made by the spoon and cautery be stuffed with iodoform gauze, and the lips of the cavity sewn together by means of a continuous suture.

Separation of Bladder. It is not a matter of great importance whether the surgeon begins by separating the bladder or by opening Douglas's pouch. If he choose the former, the line of reflection of the bladder from the cervix is ascertained by passing a bladder sound, or, as **Mr.** Herman recommends, by grasping the mucous membrane and noting the line at which you begin to be able easily to pull it from the uterus.

With a blunt-pointed pair of scissors the mucous membrane of the anterior fornix is incised in the median line just below the line of reflection of the bladder, and the incision prolonged laterally so as to surround the cervix in front. The operator cuts down until the wall of the uterus is reached, and then proceeds to strip off the bladder from the front of the cervix with the fingers, keeping close against the uterus the whole time. Any bands that resist separation by the fingers may be divided with scissors. It is most important that this separation be extended well to the sides of the uterus, for by doing so not only is the bladder saved from chance of injury in the subsequent manipulations, but the ureters are pushed well out of the way. The anterior peritoneum having been reached, is opened by pushing a sound or blunt pair of forceps through it, or divided carefully with a pair of scissors, the opening being subsequently enlarged with the fingers. In some cases, on account of peri-uterine inflammation, difficulty may be experienced in separating the bladder from the uterus, and considerable risk incurred of opening the former. Should this happen, the injury should be at once repaired. If growth is found to have extended forwards and involved the walls of the bladder, the operation may have to be discontinued. If the amount involved is small, has not involved the ureters, and there is not wide extension of growth in other directions, a portion of the bladder-wall may be removed, the opening being sutured subsequently with catgut.

Opening Douglas's Pouch. An incision is next made through the mucous membrane of the posterior fornix, so as to open Douglas's pouch. It is prolonged laterally so as to meet the extremities of the anterior incision, care being taken not to cut so deeply as to wound the uterine arteries. There is no fear of this, if the incision at the sides is made through the mucous membrane only. In making the posterior division the cervix should be held well forward by the vulsella, and the points of the scissors directed towards the uterus to avoid risk of injury to the rectum. With care there is no great risk of this accident, unless the posterior fornix has been much encroached on by the growth. The opening in the peritoneum is then prolonged laterally with scissors, or, as some prefer, enlarged by tearing with the two forefingers. A difficulty met with at this stage in entering Douglas's pouch may be due to the incision being carried through the mucous membrane only, and the peritoneum separated and pushed before the finger. It is unnecessary to pass a sponge through the posterior opening into Douglas's pouch, as recommended by some operators, unless actual protrusion of intestines takes place. Any bleeding-

[1] *Diseases of Women*, p. 380.

points in the cut edges of the vagina should be secured by pressure-forceps. A fear of hæmorrhage occurring some hours after the operation has led to various modifications of this part of the operation. In Dr. Baldy's work,[1] for instance, it is recommended that the peritoneum be sewn to the cut edge of the vagina by a continuous catgut suture; and Dr. Sinclair[2] ligatures the vaginal wall before dividing it. By these proceedings, the operation is unnecessarily complicated, and they are not required as a routine measure.

The Management of the Broad Ligaments. This stage of the operation is the one that has met with the greatest variety of treatment at the
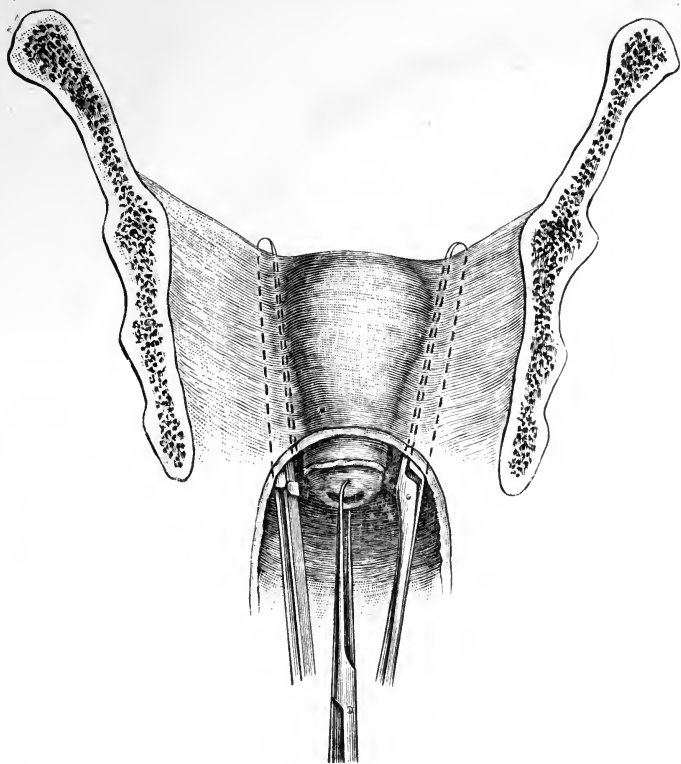
FIG. 371. Vaginal hysterectomy with clamps. (Baldy.)
Single clamp operation.

hands of different surgeons; and it is not difficult to see the reason of this. The inconveniences connected with long silk ligatures, the dangers attendant on the use of clamps, the advantages or disadvantages of closing the vaginal vault, have influenced in various degrees different operators in the choice of one variety or another. I will first describe the method of securing the broad ligaments by sutures. For this purpose a needle curved in a plane nearly at right angles to the handle is made use of, or two may be employed, curved respectively to the right and left for the corresponding broad ligaments. Commencing at the lower part of these structures, and working first on one side, then on the other, successive portions are tied with catgut and divided. As the division

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[1] *Loc. supra cit.*, p. 389.   [2] Allbutt and Playfair, *Syst. of Gyn.*, p. 688.

proceeds, the uterus is pulled lower and lower, first of all the cervix and then the body being freed from its lateral attachments. Dr. Galabin [1] has pointed out that " as soon as the centre of the uterus is divided from the utero-sacral ligaments, the fundus can generally be drawn down much further and the upper part of the broad ligament brought within reach."

The tying of the upper part of the broad ligaments is facilitated by seizing the fundus with vulsella, retroflexing it, and dragging it out through the posterior opening made into Douglas's pouch. By this
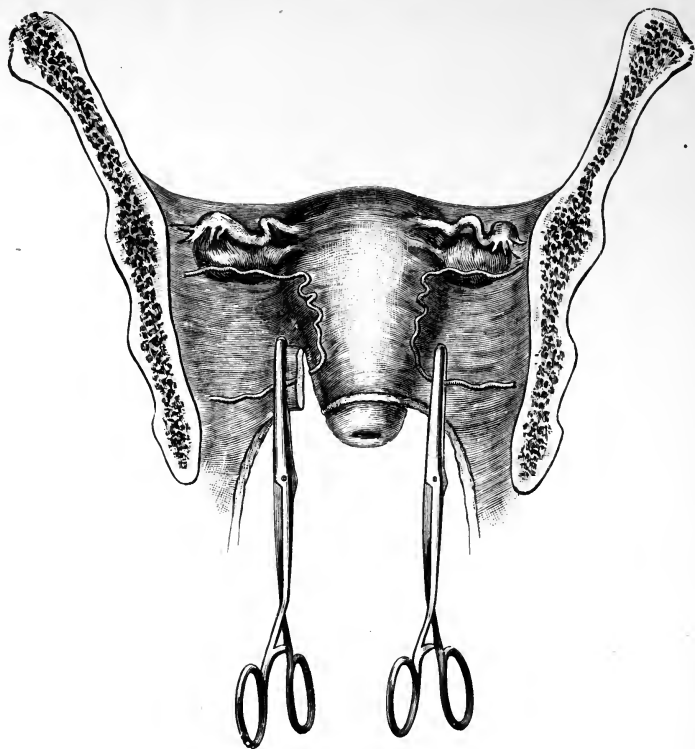
Fig. 372. Vaginal hysterectomy with clamps. (Baldy.)
Multiple clamp operation : first step.

manipulation the upper parts of the broad ligaments are brought within easy reach, and are readily transfixed by a double ligature and tied in two halves. The objections to ligatures, are these : they are more difficult to apply than clamps, and the operation takes longer. Whether ligatures or suitable clamps, properly applied, are the more liable to slip is a point difficult to decide ; secondary hæmorrhage may result from the use of either. The greatest objection to the ligature is the fact that, whatever precautions are taken, it may serve as a septic foreign body. Not even the catgut ligature is free from this reproach. A point in favour of tying the stumps is that these latter can be drawn down into the vaginal vault, and thus rendered entirely, or almost

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[1] *Diseases of Women*, 1893, p. 323.

entirely, extraperitoneal.   The method of doing so will be referred to later.

Although an equal number of objections may be urged against the use of clamps, I prefer this latter method of operating, largely on account of the greater ease and rapidity of procedure.

Against their use it has been urged that they prevent closure of the vaginal vault, and that the large open channel thus left invites contamination of the pelvic peritoneum.   But this open space provides such free drainage that peritonitis is a very rare accident, and pelvic
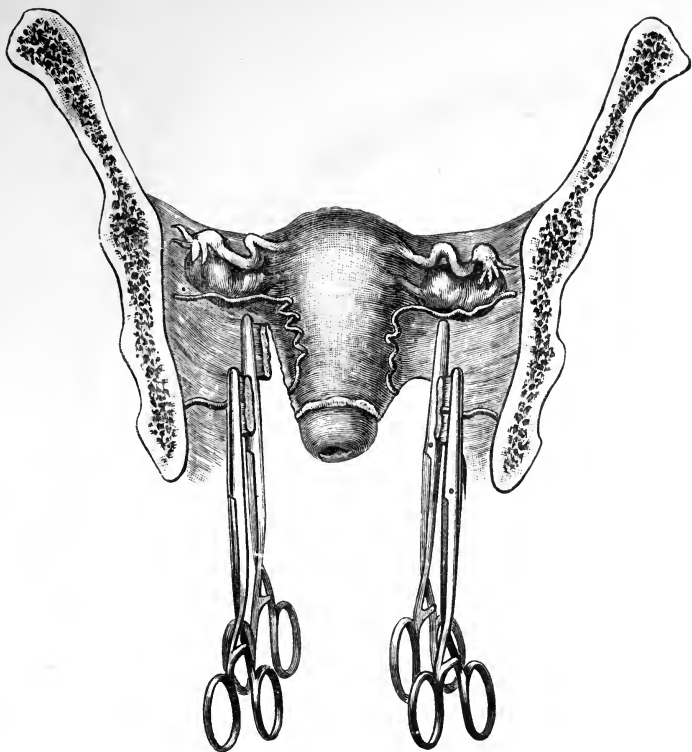
FIG. 373.   Vaginal hysterectomy with clamps.   (Baldy.)
Multiple clamp operation : second step.

abscess is seldom seen.   It is thought that there is a greater risk of including the ureter in the grasp of the forceps, or a danger of catching the intestine in the points of the forceps.   This latter may be avoided with care, and the former accident by freely separating and pushing aside the soft parts at the side of the uterus.

Numerous forms of forceps are employed for clamping the broad ligaments.   The ones I prefer are Doyen's, with strong spring blades, which come into close apposition when closed.   Either one long pair (Fig. 371) may be applied on each side, embracing the whole ligament, or two or more shorter pairs may be employed (Figs. 372, 373, 374). The latter method is, I think, preferable to the former.   It is easier to apply the forceps to a half or less of the broad ligament than to the whole of it ; there is less risk of slipping, and as the uterus is separated

from its attachments and brought lower down, there is less risk of catching
a loop of intestine in the ends of the blades. There is less objection
to the single-clamp operation if the broad ligaments are short and the
finger can readily be passed beyond them; but when they are long
and the upper border cannot be felt, the forceps should be applied no
farther than the finger can reach, the upper part of the ligament being
secured by a second pair.

In applying the forceps the front and back of the ligament are care-
fully examined by the finger, to make certain that the bladder has been
well separated at the sides, and that there is no intestine in close con-
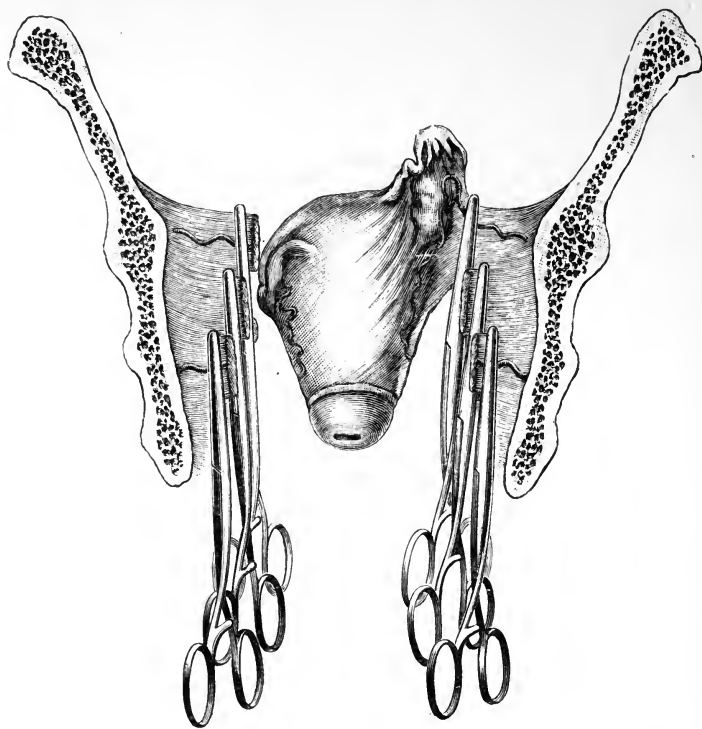
Fig. 374.   Vaginal hysterectomy with clamps.   (Baldy.)
Multiple clamp operation : third and final step.

tiguity.   With one finger in front and another behind the broad ligament,
the two blades of the forceps are guided into position, and the parts
being again carefully examined, tightened up.   If the entire ligament
is to be secured in the grasp of one pair, they must be passed beyond its
upper border, and care taken that no intestine is included.

A similar proceeding is carried out on the opposite side.   The forceps
having been applied, the ligament is divided between the forceps and the
uterus.   If the clamps have embraced a part only of the broad ligament
on each side, a second pair are now applied, and the uterus thus separated
in successive portions.   The operation as performed by Dr. Galabin
consisted in a combination of these two methods.[1]   He clamped the lower
half of the broad ligament, and tied the upper half.   The bladder having

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[1] *Diseases of Women*, 1903, p. 429.

been separated in front and Douglas's pouch opened behind as described above, a clamp is applied on each side to the lower half of the broad ligament, reaching a little above the centre of the uterus. The uterus is then cut away on each side as high up as the tips of the blades. The next step is to draw down the fundus through the opening in Douglas's pouch (Fig. 375) by means of vulsella. The upper half of the broad ligament is now within reach. It is transfixed on one side by a pedicle needle threaded with silk and tied in two halves. The uterus, now cut away on one side, is left attached by the upper half of the opposite
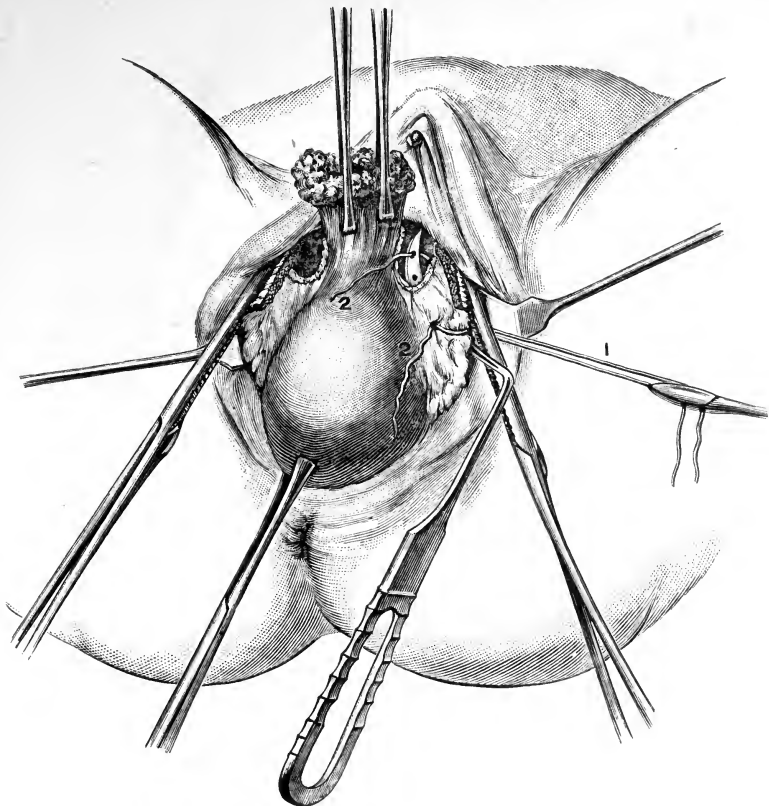
FIG. 375. Vaginal hysterectomy. (Galabin.)

Fundus retroflexed and drawn down externally. Double ligature passed through upper half of left broad ligament. One loop tied (1). End of second loop (2) being passed round broad ligament by curved pedicle needle.

broad ligament, which is tied and divided in the same way. The pedicles of the broad ligaments are finally secured to the edges of the opening in the vaginal vault in the way described in the next paragraph, the ligatures which have secured them being left long for this purpose. This mode of performing the operation is a most satisfactory one. It avoids the risk that ligatures applied to the lower half of the broad ligament have of slipping and the difficulties that often attend the application of forceps to the upper half. To allow of retroflexion of the uterus and the drawing of the fundus through the vaginal vault, care must be taken that the clamps are not applied too high up on the

broad ligaments. A cervix greatly elongated or enlarged by disease, an enlarged body, or a small opening in the vaginal vault, may prevent the operation being terminated in this way. The uterus should then be drawn down as far as possible and the remainder of the broad ligament secured with clamps.

Closure of Vault of Vagina. In this, as in the other stages of the operation, practice varies widely, some surgeons employing no sutures at all, others partially or entirely shutting off the peritoneal cavity. Where silk ligatures are employed the stumps should, if possible, be rendered extraperitoneal. This is effected as follows :

By means of the ligatures, which have been left long, the pedicle on one side is pulled down below the level of the cut edge of the vagina
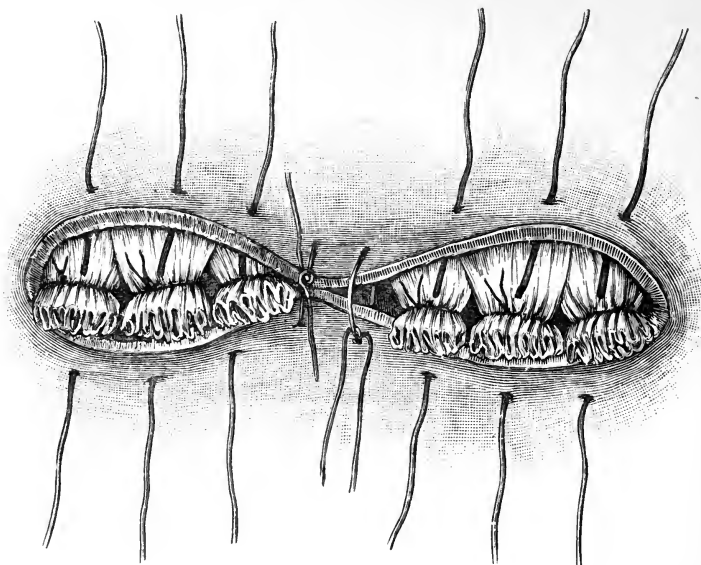
Fig. 376. Vaginal hysterectomy with the ligature-stumps drawn into the vagina, with sutures in place ready to close the opening in the vaginal vault. (Baldy.)

and fixed in position by two or three catgut sutures. The same proceeding is carried out on the opposite side (Fig. 376). By this means the peritoneal cavity is almost entirely shut off, a small opening only being left in the centre of the vault for drainage. Even this is dispensed with by some surgeons, the vaginal wound being completely closed by the insertion of one or two stitches in the median line (Fig. 376). By the employment of catgut, Olshausen has been enabled completely to close the peritoneal cavity, leaving the stumps in the pelvis. The gut ligatures are cut short and the pedicles allowed to retract within the peritoneal sac. The wound is then closed by sutures passed from before backwards through the edges of the anterior vaginal wall, the anterior layer of peritoneum, the posterior peritoneum, and the posterior wall of vagina. His success has not been obtained by others who have followed his methods. Dr. Sinclair [1] says : " After Olshausen's success in completing the operation by cutting short the broad ligament ligatures,

[1] *Loc. supra cit.*, p. 690.

and completely closing the wound in the pelvis, I tried for a time to do without drainage, but found the result unsatisfactory. Several times, owing to unfavourable symptoms which followed, it was necessary to undo some stitches in order to permit of the escape of retained fluid." Considering the difficulties of cleansing the vagina, there must always be some risk of infection during the operation, and it appears on the whole safer to provide for drainage of the pelvic pouch especially when ligatures are left within it. When forceps are employed the stumps cannot be rendered extraperitoneal. If at the time of operation there appeared to be a
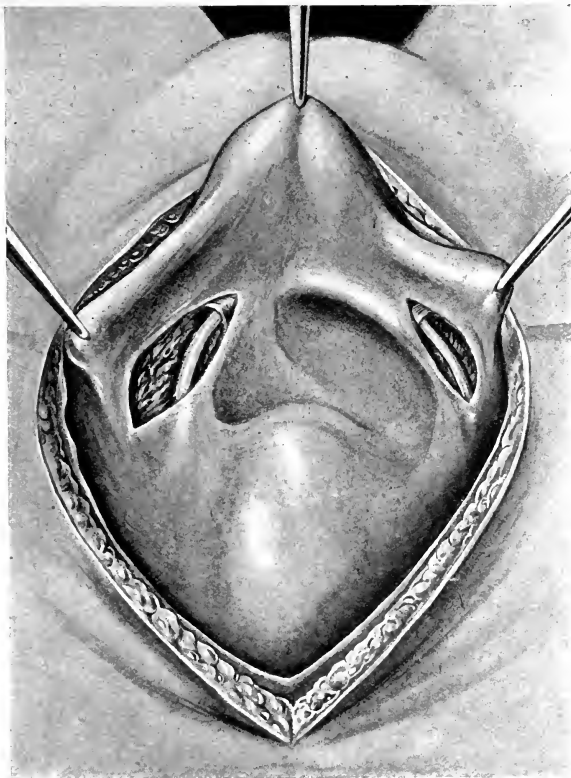
FIG. 377. Wertheim's operation. Uterus drawn forwards and peritoneum divided, exposing the ureters (after Wertheim).

tendency to prolapse of the intestines, a stitch or two might be inserted in the centre of the vaginal roof ; but otherwise they are not necessary.

After-treatment. After the removal of the uterus, the vagina is loosely packed with a strip of iodoform gauze, and if forceps are used the gauze should be wrapped round their handles where they lie in contact with the vulva. The forceps are removed at the end of thirty-six hours, and the plug of gauze renewed. When sutures are employed the gauze plug may be left in three or four days. No douche should be employed for five or six days after the operation.

B. **Abdominal Hysterectomy for Carcinoma of the Cervix. Wertheim's Operation.** Although the carcinomatous uterus had been removed

through the abdominal route by Veit, Freund and others, it is to Wertheim that the credit belongs of having put the operation on a definite and systematic basis, and it is by his name that the operation is now generally described. It has largely replaced the vaginal route as the regular method for removal. It has a wider range of utility, many cases that would not be operable by the vaginal route being dealt with successfully through the abdomen. It allows of a freer removal of the growth, and also enables enlarged glands to be sought for and removed. The operation is attended by a good deal of shock,
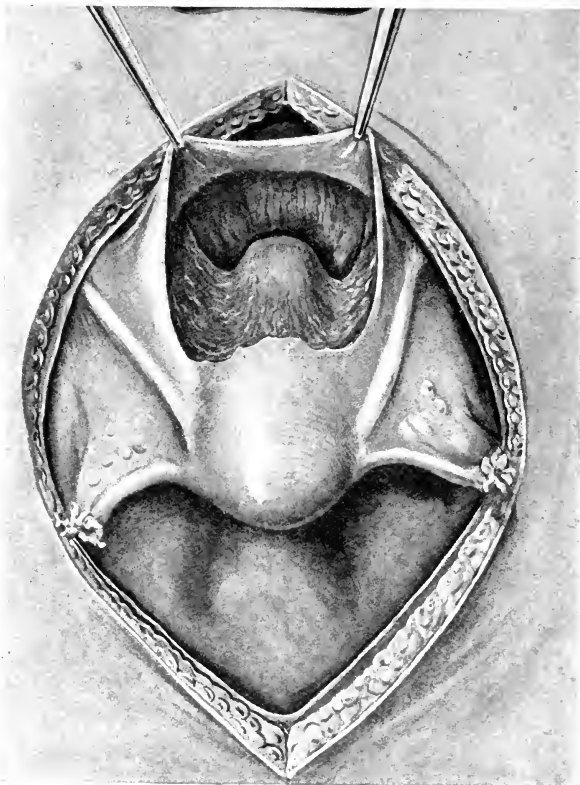
Fig. 378. Wertheim's operation. Peritoneum divided in front and bladder separated from cervix (after Wertheim).

and it is consequently not suitable for old or debilitated patients. In these the vaginal operation should be performed when possible. In very stout patients the operation becomes so difficult, that vaginal hysterectomy has to be considered as an alternative.

Preparatory Treatment. When possible, the patients should have preparatory treatment for a week before the operation. They are often run down in health as the result of hæmorrhage and discharge, and a week's rest in bed with generous feeding and vaginal douching will enable them to stand better the operation, which is a severe one. As regards preliminary treatment of the cervix, this will depend on the condition present. Where there is no foul discharge and the growth is firm and

not broken down, treatment may be limited to douching. Where foul discharge exists with ulceration of growth or polypoid masses of growth projecting into the vagina, an attempt must be made to clean the cervix up as far as possible before operation. This is carried out by means of the curette and cautery either some days beforehand or at the time of operation. The disadvantage of the cautery used beforehand is that it causes sloughs to form with a return of the discharge. I think it better to confine oneself to the curette. The best time would be just before the abdominal section is performed, were it not that it prolongs
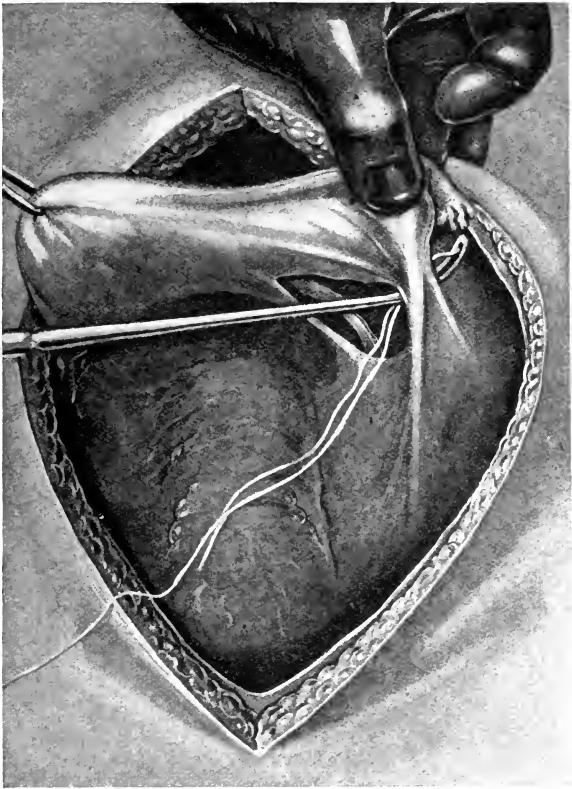
Fig. 379. Wertheim's operation. Ligature being passed round infundibulo-pelvic-ligament (after Wertheim).

the operation. On the whole it would appear to be better to curette and cleanse the cervix a day or two before the operation. Care must be taken that in doing so the scraping is not carried so far as to open up the peritoneal cavity or to injure the bladder. The disadvantage of dealing with the cervix beforehand is that it causes some inflammation in the parametric cellular tissue, rendering it more œdematous, perhaps causing more difficulty in separating the bladder and ureters, and causing the parts to be less easily recognised.

The Operation. The patient being placed in the Trendelenberg position an incision is made in the median line. This should be of good length and carried above the umbilicus. An abdominal wall retractor

may be used, but there is no doubt that the suppuration so apt to super-
vene in the abdominal wound is predisposed to by the prolonged pressure
exerted on its edges during the operation. With good anæsthesia
and assistance and a sufficiently large wound, retractors may be dis-
pensed with in many cases at all events. A thorough examination is
now made of the pelvic contents, the extent of the growth, the mobility
of the uterus, the presence or not of glands. Wide extension of growth
or masses of fixed glands will lead the surgeon to discontinue the opera-
tion. In any case of doubt, more particularly when bladder involve-
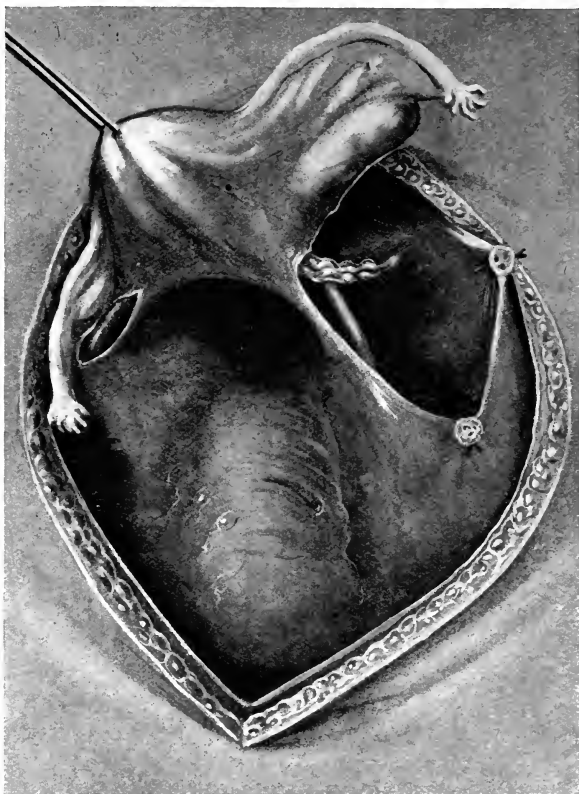
Fig. 380. Wertheim's operation. Right broad ligament divided. Uterine
vessels exposed crossing ureter (after Wertheim).

ment is uncertain, it is as well to perform one or more stages of the
operation. If it is decided to carry the operation no further the wounds
made can be sewn up and the patient will not be any the worse for the
examination.

(1) **Exposing the Ureters.** Following Wertheim's original description
of this operation the first stage consists in exposing the ureters. The
ease with which this may be done varies in different cases. They may
be seen often beneath the peritoneum, or may be felt by pinching up
the posterior layer of the broad ligament. Difficulties will be encountered
when salpingitis and pelvic adhesions exist, when the uterus cannot
be drawn well up and forwards, when the pelvis is deep and small and

when patients are unusually stout. This latter complication makes all stages of the operation extremely difficult, and in such cases the advisability of attempting the operation at all will have to be carefully considered. The ureters being found should be exposed by division of the peritoneum to their entrance into the parametrium. They should not be freed all round and so isolated from their vascular supply. Where any difficulty is experienced in finding them, this stage had better be deferred till the broad ligaments on either side have been divided.

(2) **Separation of the Bladder.** The loose peritoneum on the front of
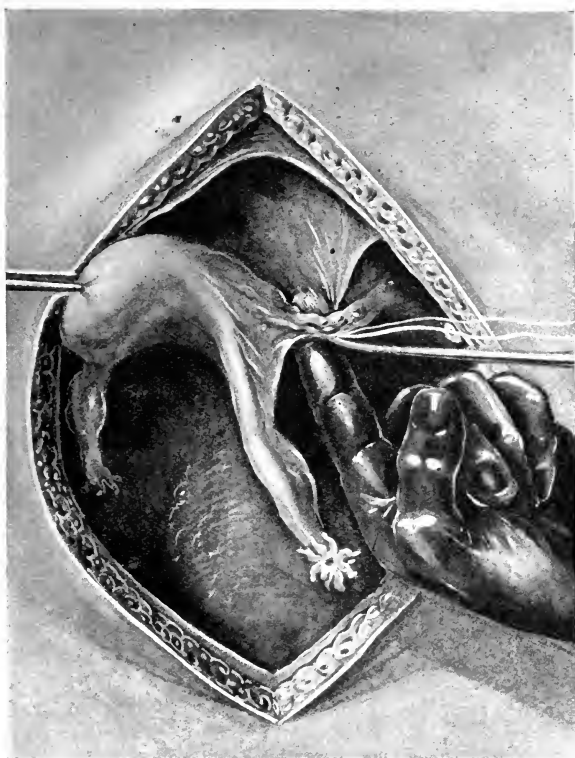
Fig. 381. Wertheim's operation. Ligature being passed round the uterine vessels (after Wertheim).

the uterus just above the bladder having been picked up and divided, the bladder is separated from the front of the cervix and upper part of the vagina. Great care must be exercised in doing this, as perforation of the bladder with the finger is easily brought about. It is best separated by means of a gauze swab aided by snips with the scissors where adhesions are firmer and particularly where bladder muscle tissue is seen left attached to the front of the cervix. Should an opening be made into the bladder it should be closed at once with catgut sutures. If the wall has not been much damaged or bruised it will probably unite, the organ being drained subsequently with a self-retaining catheter. There is risk, however, of subsequent leakage, possibly from sloughing with the formation of an urinary fistula that may be difficult to close. If the

growth is so adherent to the bladder that it cannot be removed without resecting a portion of the wall, the question of continuing or not the operation will have to be carefully considered. Unfortunately in most cases the adhesion involves the region of the trigone and ureters, and under these circumstances the operation is better discontinued. The discomfort of the patient after wide removal of bladder wall which cannot be closed, and perhaps injury to ureters, is so great that the further attempt to remove the growth is inadvisable. With a small involvement of the bladder well above the insertion of the ureters,
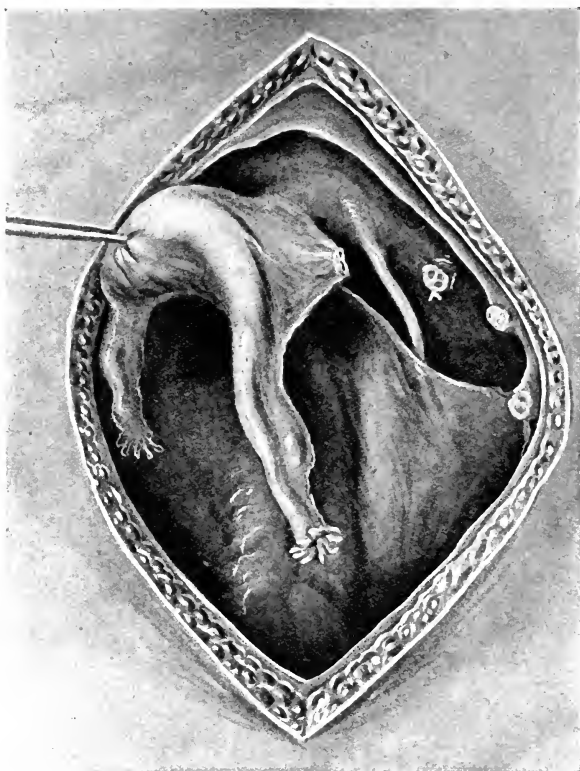
FIG. 382. Wertheim's operation. Uterine vessels divided and right ureter exposed as far as its entrance into bladder (after Wertheim).

a resection may be made and the wound carefully closed. I have found the bladder wound heal well under these circumstances without subsequent leak. With all precautions, however, a fistula may be established necessitating a further operation for its closure. This is very likely to occur in cases in which the bladder wall has been much thinned in separation, owing to much of its muscular tissue being left behind on the uterus and vagina. Apart from infiltration of its wall most difficulty will be found in the separation of the bladder close to the insertion of the ureters, and much care must be taken here not to injure them. Should a ureter be injured at this or in later stages, the best procedure is not definitely established. It is usually recommended to insert the cut end into the bladder. This I believe to be followed

often by leakage, by occlusion of the ureter or ascending pyelo-nephritis. I believe the best plan is to tie the cut end, dealing later with the kidney should trouble in that organ supervene. In the one case in which I cut through a ureter and tied it, the patient had a very little pain in the corresponding kidney and no subsequent trouble. Owing to the fact that the operation is more likely to be arrested at this stage than at any other, I prefer to begin the operation with the separation of the bladder, the ureters being exposed subsequently, either before or after the division of the broad ligaments.
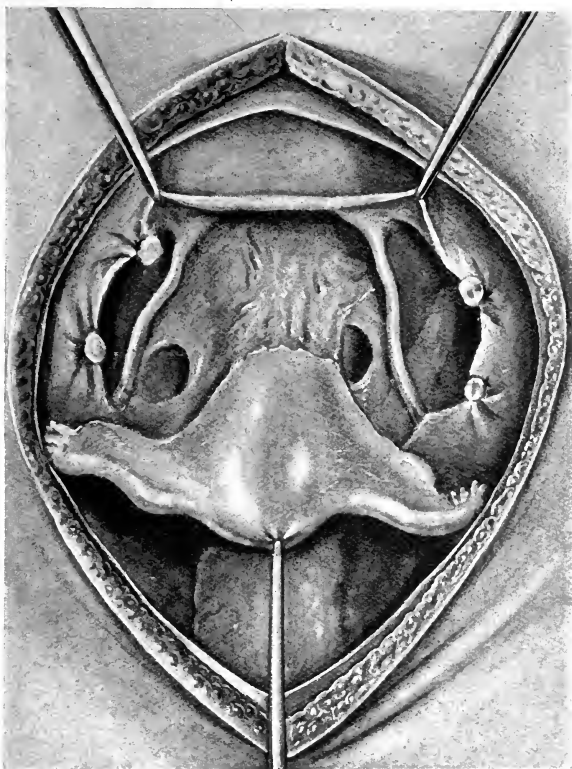
Fig. 383. Wertheim's operation. Both ureters shown exposed as far forwards as their entrance into bladder (after Wertheim).

(3) **Ligature and Division of the Broad and Round Ligaments.** These structures are tied and divided well out towards the pelvic wall, the ovarian artery being secured in the ligature passed round the ovario-pelvic ligament. The structures on the uterine side are secured by pressure forceps before division.

(4) **Ligature of the Uterine Vessels.** Having divided the broad ligaments on each side, we shall see the ureters passing forward to the base of the bladder and crossed at the level of the cervix by the uterine vessels surrounded by a certain amount of cellular tissue. The simplest way of securing these is to pass an index finger along the ureter towards the base of the bladder and beneath the vessels which are in this way safely raised from the ureters and ligatured as near to the pelvic wall

as is possible. Where there is no matting of tissues this is readily effected, but when the finger cannot be pushed under the vessels they must be carefully sought for in the cellular tissue before being ligatured and divided.

(5) **Separation of Ureters.** As soon as the uterine vessels have been divided, the ureters become accessible. They are now exposed as far forwards as their entry into the bladder. This is best effected by rendering them taut by means of a blunt hook applied behind the cervix. A few careful snips with the scissors on their inner aspect will allow them
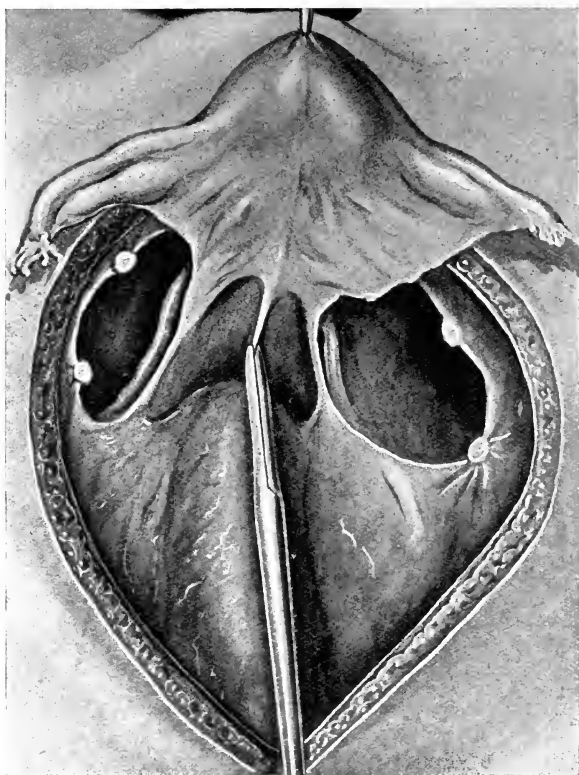
Fig. 384.   Wertheim's operation.   The peritoneum of Douglas's pouch picked up by forceps preparatory to being divided (after Wertheim).

to be drawn well aside from the cervix. They should not be detached in their entire circumference if this can be avoided.

(6) **Separation of Rectum.** The uterus is drawn well forwards and the peritoneum at the bottom of Douglas's pouch is seized in a pair of forceps and divided with scissors. Through the opening thus made, the finger is introduced and separates the rectum from the upper part of the vagina. The utero-sacral folds on each side are then seized in clamp forceps and divided on the uterine side of the forceps.

(7) **Division of Parametrium and Vagina.** The ureter being pulled well to the side of the pelvis, the parametrium is seized in strong clamp forceps, two or three being applied to each side, and the cellular tissues divided between the uterus and forceps. The uterus and upper part of

the vagina are now entirely freed, and all that remains for the removal of the uterus is to divide the vagina well below the growth. This is generally effected by clamping the vagina with strong right-angled forceps and cutting across below the forceps. Much stress has been laid on the use of the forceps applied in this way, as minimising the risk of reinfection from growth, and of sepsis.

(8) **Removal of Glands, suturing of Peritoneum, &c.** The subsequent stages of this operation, although they may be described shortly, may prove to be long and tedious. A search is made for enlarged glands, and
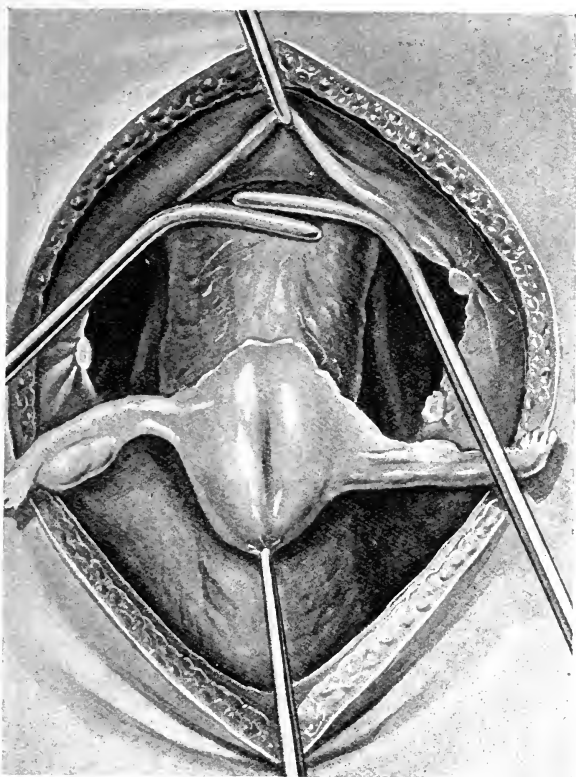
FIG. 385. Wertheim's operation. The uterus freed from its connections all round. Clamp forceps applied to the vagina (after Wertheim).

these are removed by prolonging the incision in the peritoneum backwards along the course of the iliac vessels. Ligatures are applied in the place of the forceps on the parametrium and utero-sacral folds. Bleeding constantly occurs from the lateral cut aspect of the vagina, and this should be secured by a ligature threaded on a needle. All other bleeding-points having been secured, the peritoneum where divided is sewn up with continuous catgut sutures. Before the pelvic cavity is entirely closed, a strip of iodoform gauze is packed from above into the vagina, the end of this being cut off flush with the upper cut edge of the vagina. The method of completing the operation, as usually described, is to close the peritoneum completely, and then having swabbed out the pelvis to

pressure on the abdominal vessels is relaxed, and they become filled with blood at the expense of the rest of the body. This accident should be avoided by slowly drawing off the contents of large cysts. When it occurs it should be treated by lowering the head, keeping the patient warm, and administering brandy subcutaneously.

(2) V*omiting*. This chiefly harasses by straining the intestines out of the abdomen. If prolonged, the operation must be completed as soon as possible, an assistant keeping the viscera in place with a flat sponge or gauze pad.

(3) *Separation of the Parietal Peritoneum*. It has already been pointed out that this is due to the operator mistaking the subperitoneal fat for omentum. It is an accident that may be avoided by care.

(4) *Rupture of the Cyst*. This accident may be expected when the walls are thin, necrotic, or softened by recent inflammation. In such cases the cyst should be carefully handled, suspicious spots being kept well out of the wound or packed around with sponges. If rupture occurs, the abdomen should be well irrigated with warm boiled water, and if the contents of the cyst are suppurating, drained subsequently.

(5) *Injuries to Viscera*. Of these the bladder, small intestines, rectum, and ureter are most likely to suffer. The bladder may be injured during the abdominal incision owing to its being drawn up. This, however, is not so likely to happen as in operations for fibroids. Or it may be opened in the course of removal of the tumour. Treatment consists in immediate suture of the organ, and subsequent drainage by catheter to prevent distension. The intestine is most likely to be injured in the separation of adhesions. When possible the wound in the bowel should be at once sutured. If the damage is more extensive the question of resection of a portion of gut will arise. The rectum is sometimes torn in the separation of firm adhesions in the pelvis. The operator should attempt to sew up the rent, a proceeding that will be much facilitated by the raised pelvis position and a good light. Often suturing will be found to be impossible, and in such case the neighbourhood of the injury should be well packed with iodoform gauze, the ends of which are left out of the abdominal wound, or through an opening in the vaginal vault. Sloughing of the bowel sometimes occurs after the operation, leading to the formation of a fæcal fistula. This is owing in some cases to injury of the intestine during the operation, in others to the pressure of the glass tube used for drainage. For the treatment of cases in which the ureter is injured the chapter on that subject should be consulted (p. 592).

(6) *Severe Hæmorrhage*. It has already been mentioned that severe or fatal hæmorrhage from injury to large pelvic vessels is rare. Very severe and even alarming hæmorrhage may, however, take place from the cyst wall or its interior. This is especially likely to happen when the solid contents of a papillary cyst are being scooped out by the hand. If the pedicle can be got at readily and ligatured, this should be done quickly. If not, the advice given by Dr. H. A. Kelly [1] should be followed : " The only safe plan is to control at once the main vessels going to the tumour by applying artery forceps to the broad ligament at the pelvic brim so as to catch the ovarian vessels, and one or two pairs at the uterine corner to catch the uterine vessels."

(7) *Leaving in Instruments*. *E.g.* sponge or forceps. The fact that this accident has occurred with operators of the largest experience

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[1] *Loc. supra cit.*, p. 296.

should make all careful. It is best met by having a sufficient definite number to begin with and counting carefully afterwards.

After-treatment. As soon as the patient recovers from the anæsthetic she should be gradually raised in bed by means of pillows placed behind her back, until she is supported in a sitting posture. Nothing has more effect in the relief of flatulence than this procedure. If a glass drainage-tube is made use of, she must be kept on her back till the tube is removed. The most careful attention should be paid to the bedding under her, and the nurse should see that there are no creases in the mackintosh or sheets. A few wrinkles will cause the patient the most acute discomfort.

The retching and vomiting that patients suffer from after an abdominal operation is considerably more than the anæsthetic alone will account for. Drugs should not be employed to combat the sickness. In fact, they will generally be found to be useless. The proper treatment of the stomach is rest during the first twenty hours. The only thing that should be given by mouth during this time is hot water, and of this a tablespoonful may be taken at a time as hot as can be borne comfortably. This will be found to be most acceptable to the patient, reviving her, and often removing the feeling of faintness. Ice should not be given either for the sickness or to allay thirst. The iced water remains unabsorbed in the stomach, and is sooner or later rejected. For the relief of thirst, more particularly in those cases in which nothing can be retained in the stomach, recourse should be had to " rectal salines " A pint of normal saline solution given slowly by the bowel two or three times in the first twenty-four hours after the operation, will do away with the great distress from this cause. At the end of twenty-four hours small quantities of nourishment may usually be given. It is difficult to lay down rules with regard to quantities. In a straightforward case two drachms of milk, which has been peptonised beforehand, may be given every half-hour to commence with, and the quantity gradually increased. Albumen water, made by dissolving the white of an egg in half a pint of water, may be given, mixed in equal quantities with the milk.

It is a good thing to get the bowels open early. Forty-eight hours or even earlier after the operation, an aperient should be given. Nothing is better for this purpose than an ounce of castor oil, given with a little brandy. This should be followed in eight hours by a soap enema, containing four ounces of olive oil. If the patient is comfortable and the purge does not act, leave her alone for a time and repeat the enema later. It is a mistake to keep on giving purgatives, more especially calomel, which may set up severe or even fatal diarrhœa when it does act. The unloading of the bowels will, as a rule, make the patient more comfortable, relieve flatulence from which she may have been suffering, and allow her to take more nourishment. The patient should be allowed and encouraged to pass her water naturally after the operation. If she cannot do so a catheter should be passed at the end of twelve hours, every possible precaution being taken to prevent infection of the bladder.

The routine use of opium in any form is to be avoided. On this subject I cannot do better than quote the late Mr. Greig Smith's words : " All medicines are, if possible, to be avoided, particularly opium. Pain I believe to be not so strong an indication for opium as restlessness. Sickness and tympanites are predisposed to, if not often caused by, opium. One expects, after the first dose has been administered, to see the patient wake up in the morning with a dry tongue, increased thirst,

this cause the bleeding is alarming, it should be controlled by an assistant grasping the lower part of the uterus and compressing the broad ligaments.

Extraction of Child. The uterus having been opened, the surgeon introduces a hand and seizes a knee or foot and delivers the child. It has been recommended, on account of occasional trouble in the extraction of the after-coming head, that this should be delivered first. It is not, however, easy to grasp, and will probably require both hands, which take up more room than is convenient in the uterine wound. Difficulty in extraction of the head is generally due to too small an incision in the uterine wall. The child having been delivered, the funis is tied and divided, or time may be saved by clamping it temporarily and tying the fœtal end after division. After the removal of the child, the uterus, being sufficiently diminished in size, is brought out through the abdominal wound, and a large flat sponge or gauze roll placed behind it. The placenta and membranes are then carefully peeled off the uterine wall and removed, and the interior of the uterus mopped over with 1–1000 sublimate solution. If the uterus does not contract readily, it should be stimulated to do so by compression.

Uterine Sutures. Both silk and catgut sutures are employed for this purpose. Though catgut has been largely used one or two cases have been recorded where ligatures of this material have given way, an accident I have seen happen. On the other hand, silk ligatures may become infected and lead to sinuses. On the whole, stout catgut that will not become absorbed too soon appears to be the best material. About ten deep sutures should be inserted half an inch or rather more apart. They are introduced half an inch from the edge of the wound on a half-curved or fully-curved needle, and are brought out on the cut surface close to, but not including, the decidual surface of the uterus. These are tied tightly, and if bleeding is free it is a good plan to secure some of the ligatures before they are all introduced. Superficial gut sutures are then employed to bring into apposition the cut edges of the peritoneum.

Sterilisation of Patient. To within the last few years the usual practice was to sterilise patients when the condition requiring Cæsarian section was one which could not be remedied. At the present time many surgeons are opposed to this practice. On ethical grounds it has been held that the responsibility for future pregnancies does not rest with the doctor, and in Dr. Herbert Spencer's words " that it was his duty to deliver the woman and restore her as nearly as possible to a natural condition, a result obtained by the conservative operation without sterilisation.[1] One strong point against sterilisation is that the child may die, and that the mother's chances of further pregnancy have been destroyed. On the other hand, we have the repeated risk of the operation, which however at the present day is a small one. There is further the danger of rupture of the uterus, and that this is a real one is shown by the number of cases reported of this accident. I prefer not to sterilise at the first operation, but to do so on the second occasion if the first child is alive and well and the second one holds out promise of living. If sterilisation is decided upon it is performed as follows : The tube being picked up, a double ligature, threaded on a pedicle needle, is passed through the broad ligament a sufficient distance below it. The

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[1] *Obstet. Trans.*, 1904, vol. xlvi, p. 334.

loop having been divided, the two strands are interlocked, and one is tied round the tube close to its uterine end, whilst the other is tied round the free edge of the broad ligament beyond the fimbriated extremity. The ovary should not be included in the ligature, which should be carried between it and the Fallopian tube. The tube is then cut away between the two ligatures.

The subsequent stages of the operation and the after-treatment are similar to those described in the operation of ovariotomy.

PORRO'S OPERATION

Porro's modification of Cæsarian section consists in supravaginal amputation of the uterus and fixation of the stump in the lower angle of the wound. But under this heading are now included partial hysterectomy with intraperitoneal treatment of the stump and total hysterectomy.

The simplest method, and the one best adapted for those inexperienced in abdominal surgery, is the operation devised by Porro. It has received various modifications, and that described by Mr. Herman,[1] after the method of the late Mr. Lawson Tait, may be regarded as the best on account of the simplicity of its details and the few instruments required.

The abdomen having been opened, as described in Cæsarian section, a rubber tube, two feet long, is slipped over the fundus and adjusted round the lower part of the uterus. The ends of the tube are tied in a single hitch, and prevented from slipping by being grasped in a pair of forceps. The uterus is then opened at one point, and the incision enlarged by tearing with the fingers. The child is then extracted. The uterus is now brought out of the abdomen, the ligature tightened if necessary and tied a second time. Two knitting needles are passed from side to side through the flattened rubber tube and the cervix, and the uterus cut off about three-quarters of an inch above the needles. The abdominal wound is sewn up with interrupted silkworm-gut sutures about two-thirds of an inch apart, the lowest stitch being passed through the stump below the elastic ligature, as well as through the abdominal wall. The stump is dressed with iodoform and tannic acid powder, and covered with a layer of dry dressing.

This operation carries with it numerous risks and disadvantages, and the expert operator will prefer, after removing the uterus, to treat the stump by the intraperitoneal method. The details of this operation are similar to those mentioned above in the removal of the uterus for fibroids.

Indications for the operation are as follows :

(1) Failure of the uterus to contract after removal of the child.

(2) Injuries to the uterus sustained in efforts to deliver through the pelvis, such as rupture.

(3) As an alternative to Cæsarian section when attempts have been made to extract the child through the pelvis. Experience shows clearly that the risk of the operation for Cæsarian section lies in those cases in which much manipulation by the vaginal route has been carried out beforehand.

Removal of the uterus may be indicated in the radical treatment of

[1] *Difficult Labour.*

the condition giving rise to the obstruction. This gives such further indications as follows :

(4) When the uterus contains myomatous tumours which block the pelvis, or which cannot safely be removed by myomectomy (Kelly).

(5) When there are bilateral ovarian tumours, and no sound part of an ovary can be found and left (Kelly).

(6) When the patient is suffering from osteo-malacia (Herman). The removal of the ovaries has been found to have a curative effect on this disease. In the two latter conditions the uterus is removed, as it is no longer of use to the patient after the ovaries have been taken away.

(7) When there is cancer of the cervix (Kelly). If this condition is found to exist, and hysterectomy is decided on, the whole uterus must be removed.

ECTOPIC GESTATION

From the point of view of treatment cases of extra-uterine gestation are best considered under three headings : (1) Before rupture has taken place ; (2) at the time of rupture ; (3) after rupture.

(1) **Cases in which the Tube is Unruptured.** As rupture of the tube almost invariably occurs before the tenth week, this class may be held to include cases of extra-uterine gestation up to two and a half months. If there is any suspicion that a tubal pregnancy exists, the patient should submit to operation at once. Delay means the risk of rupture and severe or fatal hæmorrhage. The operation is practically identical with that described for removal of the appendages. Adhesions are recent and do not give rise to much trouble. Care must be taken not to rupture the sac in the separation of adhesions or in drawing it up into the wound for the purpose of ligaturing the broad ligament. Should severe hæmorrhage from this cause occur, it should be controlled by quickly applying the ligatures to the pedicle, or by controlling the blood-supply at the uterine cornu and the brim of the pelvis.

(2) **At the time of Rupture.** The condition most often calling for operative measures is the result of rupture of the tube, or abortion. Rupture may take place either into the peritoneal cavity or between the layers of the broad ligament. It more often happens, however, that hæmorrhage from the tube is preceded by the formation of a mole, which the tube attempts to expel, though generally without success, from the abdominal ostium. This event is known as tubal abortion. Though likely to be continuous or frequently repeated, the bleeding is much more moderate in amount as a rule than that following a rupture, which is often profuse, and attended with grave danger to life.

Should an operation be performed in all cases in which this accident is diagnosed ? We know that many cases get well if left alone, though what proportion they bear to those requiring operation we cannot at present say. A patient occasionally dies of hæmorrhage before assistance can be obtained, whilst in many instances, on the other hand, the initial symptoms are so slight that the patient pays but little attention to them, and it is only on account of a persistence or a recurrence of pain that a surgeon is called in, perhaps weeks after the onset. When the symptoms are so grave that life is threatened, there can be no doubt as to the advisability of immediate operation. But if the patient is recovering when first seen, and the collapse and signs of hæmorrhage are not severe, the indications are less clear. There is no doubt that

in many cases no ill results will follow from delay for a time. But though the initial bleeding is slight, it may recur later with greater severity, and the danger of temporising in any recent case should consequently be fully recognised. In addition to the risk of recurrent hæmorrhage which may prove fatal, there are other points to be borne in mind. The fœtus may have survived the initial accident, and an operation performed later in pregnancy, on this account, will be attended with greatly increased risk. Bleeding may continue or recur until a large mass is formed sufficient to press on the bowel and cause symptoms of obstruction. Or the hæmatocele resulting may fail to absorb or may suppurate. I have seen a round solid clot, the size of a cricket ball, lying loose in the pelvis a year after bleeding had occurred. Even if absorption does take place, it will be followed probably by occlusion of the tubes and the formation of adhesions. When rupture or abortion has occurred recently, operation is easy. There are no adhesions or such only as can be dealt with readily. On these grounds it would appear to be safer to operate in all cases in which a recent rupture or abortion has been diagnosed, abdominal section being performed and the tube removed. Putting on one side those cases in which an operation is immediately demanded on account of profuse hæmorrhage, the mortality of the operation is very small. Convalescence after removal of the tube and blood-clot is, moreover, much shorter than in those cases where we wait for the absorption of the hæmatocele. If a diagnosis of rupture into a broad ligament can be made, it is perfectly justifiable to wait awhile, as the hæmorrhage will, in all probability, soon cease, and the hæmatocele can, if necessity arises, be dealt with later by drainage.

The Operation. An incision, four to five inches long, is made in the median line and carried well down to the pubes. If the case is a severe one, blood may at once escape from the abdomen when the peritoneum is opened. This is mopped and scooped out as rapidly as possible, and if it appears that hæmorrhage is continuing, no attempt should be made to cleanse the peritoneal sac, but the bleeding should be controlled at once. This is done by identifying the fundus and tracing the affected tube outwards from this. The sac is drawn up towards the wound, and a pair of Spencer-Wells forceps are applied to the uterine end of the tube, so as to include in its grasp the terminal branches of the uterine artery, and a second pair to the broad ligament at the brim of the pelvis to secure the ovarian artery. The abdomen can then be cleansed by means of sponges or by washing out with warm water, and the parts inspected. The tube is then brought up into the wound and ligatures applied, as described in the section on the removal of the appendages.

(3) **After rupture of Sac.** Under this heading may be included those cases which are seen some time after rupture or abortion has occurred. Treatment then resolves itself into dealing with a collection of blood in the pelvis, either shut off by adhesions and matted viscera from the general peritoneal cavity, or lying between the layers of the broad ligament.

If on account of recurrent attacks of pain and marked anæmia there is reason to suspect repeated hæmorrhages, abdominal section should be performed and the tube removed. This will differ from the operation undertaken at the time of rupture in that the tube and blood-clot will be found enclosed by adhesions and matted bowel and omentum. These latter must be carefully separated until the sac and surrounding blood-clot are brought into view. The tube is then dealt with as pre-

viously described. If some time has elapsed since the accident and the hæmatocele, more especially if it is a small one, shows signs of undergoing absorption, the case may be treated by rest, in the hope that the swelling will subside.

If there are no signs of fresh bleeding, and the hæmatocele, which is bulging down Douglas's pouch, shows little tendency to diminish in size as the result of rest, it should be treated by drainage through the vagina. This operation should not be performed within the first two weeks following the rupture, or when evidence exists that bleeding is continuing. Violent hæmorrhage may be set up on opening the sac, and a fatal result has been known to follow. It would be better under these circumstances to open the abdomen, clear out the blood clot and remove the tube. When rupture has taken place into the broad ligament, Dr. Kelly [1] considers that the proper treatment is to evacuate and drain the sac extraperitoneally, either by the vagina or above Poupart's ligament. It should be opened in the latter situation when " the sac elevates the peritoneum of the anterior abdominal wall, so as to be easily accessible from the front." In most cases, however, blood poured out in this situation is moderate in amount and undergoes absorption. Unless, therefore, the swelling is a large one or it is undergoing suppuration, a rare accident, it may be left alone.

If the fœtus survives the patient runs the risk of a secondary rupture, and as pregnancy advances operation is attended with increasing danger. It is said by Pinard to be no greater at full time than it is during and after the fifth month. During the first four months of gestation there is no doubt about the advisability of immediate operation, and the removal of sac, fœtus and placenta may be attempted. After this time the increase in size of the placenta calls for a different line of treatment. Operations undertaken after the death of the fœtus at full term are attended by less danger of hæmorrhage, owing to the shrinkage of the placental vessels. In any case that is diagnosed towards the end of pregnancy it would, in consequence, be sound treatment to defer the operation for some weeks after full term. Though the risk of death from hæmorrhage is thereby greatly diminished, this delay is attended by the possibility of putrefactive changes taking place in the placenta. As the child will most probably be weakly and is often malformed, any measures undertaken should be in the interest of the mother rather than of the child. The question of operating at full term for the sake of saving the child is consequently not one that should carry much weight.

An incision should be made in the median line, and low down to begin with between the symphysis and umbilicus to avoid the possibility of injury to a placenta seated in the upper part of the sac. [2] The difficulties of removal of the sac are so great and so fraught with danger, that the safest plan of dealing with it is to suture its edges to the abdominal incision. Where possible the peritoneal cavity should not be opened. The greatest difficulty that the surgeon has to contend with is the placenta. If some weeks have elapsed since full term it can be removed as a rule without difficulty. It can also be removed in some cases before or at full term in which it is situated in the upper part of the sac. If the placenta cannot be removed with the sac

but is attached low down, the best plan is to tie the cord close to the placenta without disturbing the latter, and to pack the cavity with iodoform gauze. At the end of a fortnight to three weeks an attempt is made to remove the placenta, the packing of the sac being continued till it is obliterated. The great risk of this procedure is septic infection before the placenta can be removed. Another plan is to close the abdominal wound leaving the placenta *in situ*, trusting to atrophy and absorption of the latter taking place. Owing to the close proximity of the bowel, infection is a not unlikely contingent, and the wound may have to be re-opened on account of suppuration.

CHAPTER XLVI

LIGATURE OF VESSELS

EXTERNAL ILIAC. COMMON ILIAC. INTERNAL ILIAC. ABDOMINAL AORTA

SURGICAL TREATMENT OF ABDOMINAL ANEURYSM

LIGATURE OF THE EXTERNAL ILIAC (Figs. 386 and 387)

Indications. Chiefly : 1. *Some cases of aneurysm of the upper part of the femoral, or of the femoral encroaching on the external iliac itself.* Mr. Holmes[1] shows that in ilio-femoral aneurysms it is often very difficult to say whether the aneurysm is or is not limited to the iliac or femoral, *i.e.* whether it is wholly above or below the place where the deep epigastric and circumflex iliac come off, or whether the mouths of these vessels open out of the sac. In the former case the aneurysm would be purely iliac or femoral ; in the latter, ilio-femoral.

In ruptured femoral aneurysm the old operation (facilitated by the application of a tourniquet above) would usually be indicated, but Mr. Southam[2] has briefly reported a case in which he tied the external iliac successfully in a patient whose femoral aneurysm suddenly ruptured and became diffuse. The effused blood was quickly absorbed, and there was never any tendency to gangrene. Complete power over the limb was regained.

2. *Wounds.* A wound of the external iliac is very rare.[3] The artery has been frequently tied for hæmorrhage from parts below, *e.g.* for reactionary and secondary hæmorrhage after wounds of the femoral high up, after ligature of the femoral, and after amputation at or near the hip. The futility of this treatment is thus shown :

Dr. Otis[4] gives a summary of twenty-six cases in which the external iliac was tied for such cases as the above. Of these, twenty-three ended fatally, a mortality of 88·4 per cent. The uselessness of trusting to ligature of the external iliac in such cases, instead of either securing the wounded vessel itself, or trusting to well-applied pressure, was long before this insisted on by Guthrie.[5] This question is alluded to again below, but in proof of the above statement a case may be mentioned here, in

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[1] R.C.S. Lect., *Lancet*, 1873, vol. i.

[2] *Brit. Med. Journ.*, 1883, vol. i, p. 818.

[3] The only case with which I am acquainted is one quoted by Mr. Erichsen from Velpeau (*Nouv. Elém. de Méd. Opér.*, t. i, p. 175), in which the above French surgeon was suddenly called upon to tie the external iliac for a knife-wound. Though there had been no preliminary dilatation of the collateral circulation either by pressure or by the presence of an aneurysm, the result was successful.

[4] *Med. and Surg. History of the War of the Rebellion*, pt. iii, p. 788.

[5] *Wounds and Injuries of the Arteries*, Lects. v and vi.

which hæmorrhage returned after ligature of the external iliac, and was arrested by well-applied pressure. The patient had been wounded, January 15, 1865, by a minié ball, entering at the upper and inner part of the thigh, and emerging near the knee. The wound becoming sloughy, hæmorrhage occurred (March 23 and 31), and the external iliac was tied. April 21, hæmorrhage recurred from the upper gunshot wound, and was successfully restrained by a horseshoe tourniquet, constantly kept on for two weeks, when it was omitted, without any subsequent hæmorrhage. The wounds were now healing kindly, when (May 31) dysentery set in, carrying off the patient, June 15, two and a half months after the operation of ligature.

It is far better to open the wound so that the actual source of bleeding can be found and the vessels tied below, as well as above, the bleeding spot. Mr. Pringle [1] has successfully sutured a wound of the external iliac. The opening was a quarter of an inch long and was sewn up with catgut, which produced a kink in the artery, but no leakage took place, and six months later the man was quite well and able to work. The deep circumflex iliac artery was tied, because it originated a quarter of an inch below the incision in the artery. During the operation bleeding was prevented by pressure on the abdominal aorta. This brilliant result adds another reason for opening the wound and seeking the bleeding spot in all cases of hæmorrhage from a wound near large vessels.

3. *Elephantiasis.* Ligature of the external iliac or femoral (when the condition of the soft parts admit of it) has been extolled by some surgeons in the treatment of this affection. [2] A larger experience shows, however, that when cases thus treated are watched, the cures cannot be relied upon as permanent. Moreover, too little value has been attached, in reported cures by ligature of the main vessel, to the thorough rest and elevated position entailed by tying the artery.

Handley's operation of lymphangioplasty is far more hopeful, but this operation cannot be safely undertaken when cracks, foul ulcers, or bacterial infection make asepsis impossible for mild cases. Martin's bandages are sufficient.

4. *As a distal operation in aneurysm of the common iliac.* Ligature of the external iliac has been so unsuccessful here as to call for no further comment.

Surgical Anatomy.

Extent. From the lumbo-sacral articulation to a point just internal to the centre of Poupart's ligament. *Length.* Three and a half to four inches.

Surface Marking. From a point an inch below and to the left of the umbilicus to a point just internal to the centre of Poupart's ligament.

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[1] *Scottish Med. and Surg. Journ.*, October 1901.

[2] An apparently successful case is reported by Mr. Leonard, of Bristol. Measurements are given nearly three years after the operation, showing that the success was then maintained. Five years later the patient reported that " his leg was much the same " as at the last report. Bandaging does not appear to have been made use of here. Prof. Buchanan (*Brit. Med. Journ.*, November 23, 1867 ; *Syd. Soc. Bien. Retr.*, 1867–8, p. 300) reports a case, seven months after the operation, apparently cured by ligature of the external iliac, after failure of rest and methodical compression (this was before the introduction of Martin's bandage). Three months later it is candidly stated that the disease had recurred to a considerable degree. Dr. White, of Harvard University (*Internat. Encycl. of Surg.*, vol. ii, p. 631), quotes Wernher (reference not given) as having followed up thirty-two cases ; in all there was an immediate reduction of size, but the relief was permanent in three only. Dr. Pinnock, of Melbourne (*Lancet*, 1879, vol. i, p. 44), gives a case in which no permanent benefit followed on ligature of the femoral artery.

In Front

Relations :

    Peritoneum, small intestines.
    Iliac fascia.
    Lymphatic glands and vessels.
    Genito-crural nerve (genital branch).
    Spermatic vessels   } Crossing artery near Poupart's
    Circumflex iliac vein   }   ligament.

Outer Side		*Inner Side.*
Psoas (above).	External iliac	Iliac fascia.
Iliac fascia.	artery.	Vein.

Behind

Iliac fascia.	Vas deferens (dipping
Vein (above).	from internal ring
Psoas (below).	to pelvis).

Collateral Circulation.

Deep epigastric	with	Internal mammary, lower intercostals, and lumbar.
Deep circumflex iliac	,,	Ilio-lumbar, lumbar, and gluteal.
Gluteal and sciatic	,,	Internal and external circumflex.
Comes nervi ischiadici	,,	Perforating branches of profunda.
Obturator	,,	Circumflex arteries and epigastric.
Internal pudic	,,	External pudic.

Operation. (1) By the lower and more transverse incision of Sir A. Cooper. (2) By the muscle slitting extra-peritoneal method. (3) By the higher and more vertical incision of Abernethy. The two are compared at p. 897. (4) By the intra-peritoneal method (p. 903).

(1) *Incision of Sir A. Cooper.* This is the method more frequently made use of. An incision is made four inches long (four and a half to five if there be very much fat, or if the parts are pushed up by a contiguous aneurysm), parallel with Poupart's ligament, and nearly an inch above it, commencing just outside the centre of the ligament and extending outwards and upwards beyond the anterior superior spine.[1] The superficial fascia and fat, varying in amount, being divided, and the superficial circumflex iliac vessels secured, the external oblique, both fleshy and aponeurotic, is cut through, and then the fleshy fibres of the internal oblique and transversalis. This is done either by using the knife alone, lightly and carefully, or by taking up each layer with forceps, nicking it, and slitting it up on a director. If the wound be sponged carefully, a layer of cellular tissue can usually be seen between the muscles, however thin they are. Any muscular branches should be secured with forceps as soon as cut. The fascia transversalis, when exposed, will be found to vary a good deal in thickness and in the amount

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[1] The incision may have to be made higher than usual, owing to the upward extension of the aneurysm, to enable the surgeon to tie either the upper part of the external or the common iliac. On this point see the remarks on the comparison of Cooper's and Abernethy's operations, p. 897. Often in these cases of upward extension of the aneurysm the sac is found to involve the lower part of the artery, and to have overlapped the upper portion.

of fat which it contains. It is to be divided very carefully,[1] and the extra-peritoneal fat, if present, will next come into view. First one and then two fingers being introduced, the peritoneum is to be gently stripped up from the iliac fossa towards the middle line, *i.e.* upwards and inwards as far as the inner border of the psoas.[2] In doing this care must be taken, especially in the dead body, not to separate the iliac fascia and the vessels from their position on the psoas, not to tear this muscle, and not to lacerate the peritoneum. As soon as the peritoneum has been well raised, an assistant keeps this and the upper lip of the wound well out of the way by means of broad retractors. The surgeon then feels for the pulsation of the artery on the inner border of the psoas, and carefully opens the layer of fascia which ties the vessel to the psoas,
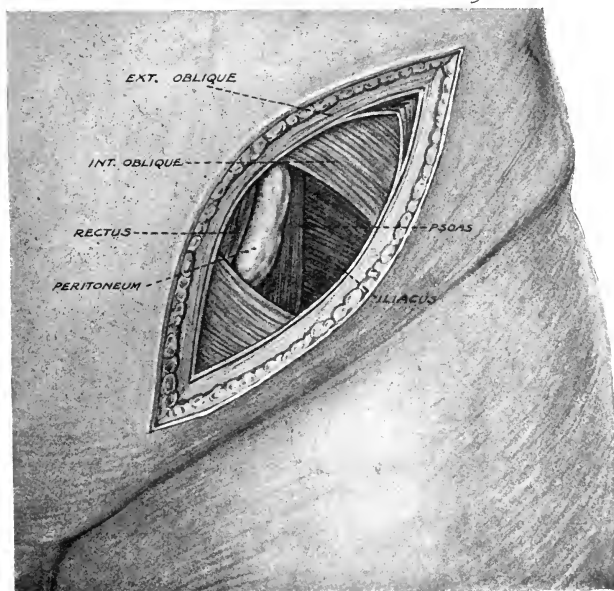
FIG. 386. The gridiron incision for exposing the iliac vessels. The peritoneum is drawn in. The rectus sheath is always opened to give more room.

and forms a weak sheath to it. This should be done one and a quarter inch above Poupart's ligament, so as to lie well above the origin of the deep epigastric, which usually comes off a quarter or half an inch above Poupart's ligament, and the needle passed from within outwards, care-

[1] Dr. Sheen (*Brit. Med Journ.*, 1882, vol. ii, p. 720) thus writes of the accident which may happen here : " I made the incision somewhat too high, and, in consequence, opened the peritoneum, which I mistook for transversalis fascia. Even then I was in a little doubt, because some (omental) fat presented itself, which very much resembled the fat seen in the previous case (fat around the vessel), but, in pushing this up gently, a knuckle of bowel came into view, which settled the matter." The wound in the peritoneum was sewn up, and the case did perfectly well.

[2] Great care is needed here if the peritoneum be adherent. This condition, when present, is usually found above. It is especially likely in long-standing cases, and where the aneurysm has caused irritative and inflammatory changes. By some it is held that the transversalis fascia can always be stripped up along with the peritoneum. As this fascia is thickened and attached, close to Poupart's ligament, to form the deeper crural arch and front of the femoral sheath, it is very doubtful if it can ever be detached unless it be divided or torn through. The latter is very easy on an aged corpse.

fully avoiding the vein on the inner side and the genito-crural nerve
outside and in front.   In difficult cases the ligature (of sterilised silk)
must mainly be passed by touch, but a free incision, adequate use of
retractors, and light thrown in by a large mirror will usually allow the
surgeon to see what he is doing.   The effect of tightening the ligature
being satisfactory, it is cut short and dropped in, the divided muscles
are then brought together with buried catgut sutures, and the superficial
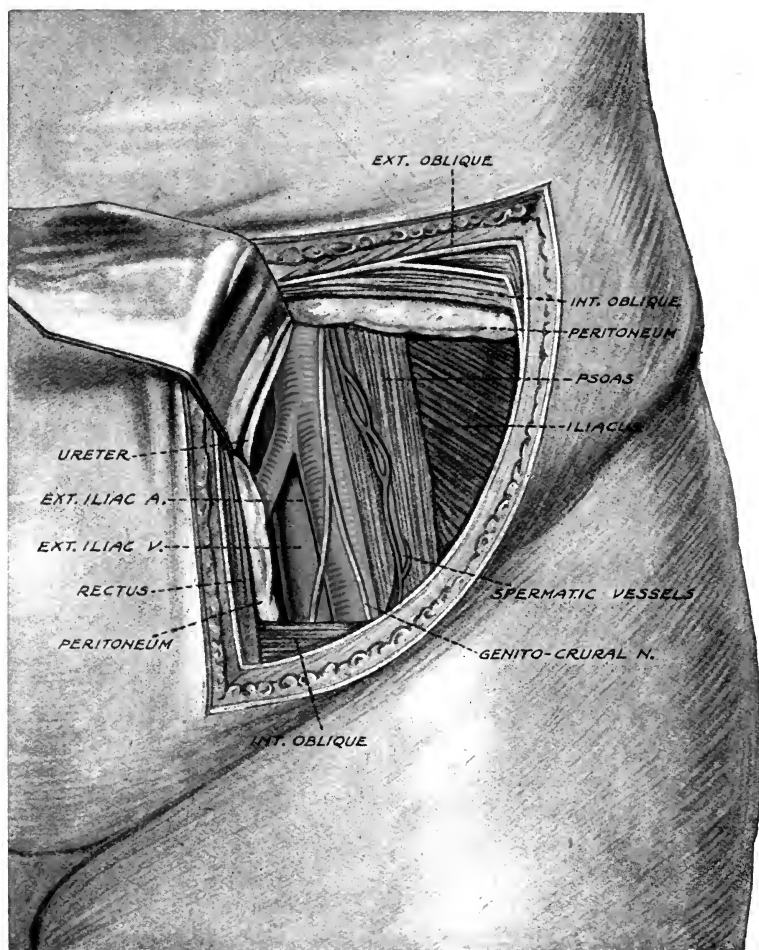
Fig. 387.   The relations of the iliac vessels are well shown.   The gridiron
incision prolonged into the rectus sheath has been used.

wound closed.   The parts must be kept relaxed by propping the chest
up slightly and flexing the knees over a soft pillow.   The limb is evenly
bandaged from the toes upwards, raised, and kept covered in cotton-
wool, with hot bottles placed in the bed.   In case of threatening gangrene
assistants should persevere in a trial of friction of the limb from below
upwards.

(2) After slitting the external oblique as described under Cooper's
operation, the fibres of the internal oblique and transversalis muscles

are separated, as in McBurney's operation for appendicitis. The wound can be enlarged if necessary by cutting into the rectus sheath and drawing the muscle inwards. By adopting this method the risk of ventral hernia is greatly diminished, and the difficulties of the operation are not materially increased, if good retractors are used (*see* Fig. 387).

(3) *Incision of Abernethy.* In his first operation this surgeon made his incision in the line of the artery for about three inches, commencing nearly four inches above Poupart's ligament. Later on he modified his incision by making it less vertical and more curved, with its convexity downwards and outwards, and extending between the following points, viz. one about one inch internal and one inch above the anterior superior spine to one inch and a half above and external to the centre of Poupart's ligament.

The respective **advantages** and **disadvantages** of the methods of Cooper and Abernethy appear to be the following : Cooper's is rather the easier, interfering, as it does, with the peritoneum less and lower down. It is most suitable to those cases which do not extend far, if at all, above Poupart's ligament. On the other hand, where the extent to which the aneurysm reaches upwards is not exactly known, Abernethy's operation, hitting off the artery, as it does, higher up, or some modification of that given (p. 901) for ligature of the common iliac, will be found preferable.

Difficulties and Possible Mistakes. (1) Too short an incision. Here, as in colostomy and other deep operations on the abdominal wall, every layer must be cut to the full extent of the superficial ones. Otherwise the operator will be working at the bottom of a conical, confined wound. (2) A wrongly placed incision, *i.e.* one which, by going too near the middle line, opens the internal abdominal ring, or which, if too low, may come too near the cord. (3) Disturbing the planes of cellular tissue needlessly or roughly. (4) Wounding the peritoneum, owing to a hasty incision through a thin abdominal wall, by rough use of a director, especially if the peritoneum is adherent in the neighbourhood of the sac, or fused with the transversalis fascia. The peritoneum is often difficult to distinguish ; it is bluish in aspect, but of course not smooth, being covered with cellular tissue which connects it to the extra-peritoneal fat. (5) Stripping up the peritoneum roughly and too far. (6) Detaching the artery from the psoas. (7) Lacerating the psoas. (8) Tying or injuring the vein. (9) Including the genito-crural nerve. (10) An abnormal position of the artery. This may be due to an exaggeration of that naturally tortuous condition of the artery which is especially likely to be met with in patients advanced in life. Another unusual cause of displacement may be met with in extravasated blood when an aneurysm has given way.

Sir W. Fergusson briefly reported [1] an instance of this kind, in which the sac gave way after repeated manipulation.

Causes of Failure and Death. 1. *Gangrene.* In some cases, where the limb does not become gangrenous, the vitality is very feeble and requires much attention.

Thus, in Mr. Rivington's case,[2] loss of sensation was noticed on the fourth day, followed by paralysis of most of the muscles. Though gangrene did not appear,

[1] *Brit. Med. Journ.*, 1873, vol. i, p. 286.   *Clin. Soc, Trans.*, vol, xix, p. 45.

and the patient survived five and a half months, the limb was " on the verge of gangrene," as shown by sores appearing on the heel and great toe.[1]

2. *Secondary hæmorrhage.* This was not uncommon when wounds became septic, especially if silk was used. It is mentioned here as a warning of the need of perfect asepsis.

Thus, in Mr. Rivington's case,[2] the patient died of secondary hæmorrhage five and a half months after the operation ; the wound had been found septic at the first dressing ; a catgut ligature was used.

Early recurrence of pulsation may be ominous of secondary hæmorrhage.

In a case of Sir A. Cooper's, the hæmorrhage which proved fatal a fortnight after the operation was found to be due to a large collateral, viz. an abnormal obturator arising immediately above the site of ligature.[3]

3. *Phlebitis* from injury to the external iliac vein.

4. *Suppuration of the sac with its attendant dangers of septic infection and secondary hæmorrhage.* This accident used to occur in some cases of inguinal aneurysm after ligature. No pains should be spared to prevent its occurrence by taking every step to keep the wound strictly aseptic from first to last, and thus to secure early and sound healing. Absolute rest should also be enforced upon the patient.

5. *Recurrence of pulsation.* This is especially likely to occur when a catgut ligature has been used and given way, owing to its being too quickly absorbed. Over-free collateral circulation will cause recurrence of pulsation quickly ; and melting down of soft coagulum (this appearing to be all that the blood can do in the way of clotting) will bring about the same cause of failure later on. In these cases the following courses are open in the matter of the external iliac, viz. well-adjusted and carefully-maintained pressure, and the old operation. Ligature of the vessel lower down, *i.e.* between the first ligature and the aneurysm, and amputation are not available here. Two other conditions which may supervene and prove troublesome should be mentioned here, viz. :

6. *Formation of a ventral hernia.* This should be prevented as far as possible by ensuring primary union, and by separating the muscle fibres instead of cutting across them. Later on, if this complication threaten, an appropriate truss should be worn.

LIGATURE OF THE COMMON ILIAC (Figs. 386 and 387)

Indications. Very few. For gangrene of the foot frequently follows the operation. Temporary ligature may induce clothing in an aneurysm without risk of gangrene.

1. *Aneurysms.* Especially those inguinal aneurysms which affect the external iliac in its upper part, above the origin of the deep epigastric, occupying the iliac fossa and lower part of the abdomen.

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[1] In one of Dr. Sheen's cases already referred to, four days after the operation a large patch of skin on the outer side of the thigh was noticed to be darkish in colour, and to pit on pressure, though normal as to sensation. The case did quite well.

[2] *Loc. supra cit.*

[3] Roux, *Parallèle de la Chir. anglaise avec la Chir. française, &c.*, pp. 278, 279.

When such aneurysms are progressing steadily, when they have resisted a trial of pressure, or are becoming diffuse, and are not thought amenable to the old operation, ligature of the common iliac is indicated.

2. *Wounds.* These may be gunshot or bayonet wounds, or knife-stabs of the vessel itself, or the internal iliac or its branches, usually the latter. Bleeding from these branches is best treated by opening the wound identifying the vessel and securing it on each side of the bleeding spot; failing this the *internal* iliac should be tried. The hæmorrhage calling for ligature seems to be usually secondary.[1]

Dr. S. Smith[2] gives two cases of ligature of the common iliac for wounds:

> One was from a musket-ball which injured the vessel itself, passed through the intestines, and lodged in the sacrum. The operation was performed by opening the peritoneal cavity. Peritonitis soon set in; secondary hæmorrhage recurred repeatedly, and the case ended fatally on the fifteenth day. The other case is of great interest, as the common and internal iliac were here tied for severe hæmorrhage after a stab in the inguinal region. A large quantity of blood was found in the peritoneal cavity, and the patient died ten hours after the operation. At the necropsy it was found that the deep epigastric was the wounded vessel.

Dr. Otis[3] records four cases of ligature of the common iliac during the American Civil War. The results were vitiated by sepsis.

3. *For the arrest of hæmorrhage* after amputation near the hip from the branches of the internal iliac in what is usually the posterior flap.

4. *For pulsating tumours simulating aneurysm.* As these growths from the iliac fossa and the walls of the pelvis have been found to be malignant, it is of the utmost importance to form a correct diagnosis in these cases, and thus save a patient who has a certainly fatal disorder from being submitted to an operation which is most dangerous, and almost certain to be useless.[4] As mistakes have, however, been made in these cases by excellent surgeons,[5] the chief points of diagnosis, as given by Mr. Holmes,[6] may be briefly mentioned here: (1) The bruit is usually less well marked; (2) the pulsation is less heaving and less expansile; (3) the condition of the bone with which the swelling is connected; thus a plate of bone may be found in the supposed aneurysmal sac; the supposed aneurysm may be found both on the gluteal and the iliac aspects of the pelvis, the bone being expanded by the growth. (4) Cancerous cachexia may be present, and perhaps secondary growths as well. To these may be added the valuable evidence which may be given by the X Rays.

5. *For hæmorrhage, not the result of a wound.* Ligature of the common

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[1] It would naturally be thought that hæmorrhage from a wound of the common iliac would be fatal before a ligature could be applied. Dr. Otis gives a case in which this vessel was wounded by a ball entering from the buttock through the sacro-iliac synchondrosis. Death took place from hæmorrhage on the second day.

[2] *Amer. Journ. Med. Sci.*, 1860, vol. xl, p. 1.

[3] *Med. and Surg. Hist. of the War of the Rebellion*, pt. ii, p. 333.

[4] In Guthrie's case, a pulsating tumour in the right buttock, the size of an adult head, diminished by one-half in a month. Two months later it again enlarged, and the patient dying eight months after the operation, an immense encephaloid tumour was found occupying the right iliac region.

[5] *E.g.*, Guthrie (*Lond. Med. Gaz.*, vol. ii, 1834); Stanley (*Med.-Chir. Trans.*, vol. xxviii); Moore (*ibid.*, vol. xxxv).

[6] *Syst. of Surg.*, vol. iii, pp. 44, 145. The reader should also consult Mr. Holmes's article, " On Pulsating Tumours which are not Aneurysmal, and on Aneurysms which are not Pulsating Tumours " (*St. George's Hospital Reports*, vol. vii).

iliac has been employed in some cases of this nature, usually secondary hæmorrhage after ligature of the external iliac, the gluteal and sciatic, or after rupture of the external iliac. Ligature of the main trunk has been so fatal here that it should be abandoned ; carefully applied pressure, aided by plugging with aseptic gauze, or the old operation, being certainly preferable.

Mr. Morrant Baker [1] has put on record a case of great interest in diagnosis, in which an abscess from sacro-iliac disease ulcerated into branches of the internal iliac artery, and when opened gave rise to hæmorrhage calling for ligature of the common iliac. A gardener, aged 17, had felt pain a month previously while digging. A tense, elastic swelling, distinctly fluctuating, and acutely tender, occupied all the right buttock. It was opened, and a small stream of apparently arterial blood escaped without jets. On further exploration the finger entered a large cavity between the iliac bone and the glutei. The iliac fossa was full and tense, and on examination per rectum a swelling was found in the right ischio-rectal fossa. On enlarging the gluteal wound a steady stream of arterial blood welled up through the great sacro-sciatic foramen. This was firmly plugged, and the common iliac tied. On removing the plug some bleeding still occurred, but was easily arrested. The gluteal wound became offensive, and this region, together with the upper part of the thigh, became gangrenous, the leg and foot remaining unaffected. The patient died forty hours after the operation.

At the necropsy the sacro-iliac joint was open, with surrounding caries. The remains of a large abscess were found, involving the branches of the internal iliac. There was no trace of aneurysm.

Surgical Anatomy. The common iliacs, coming off on the left side of the fourth lumbar vertebra, incline downwards and outwards to divide, opposite to the lumbo-sacral intervertebral disc, into the internal and external iliacs. The right is rather the longer and more oblique of the two. Their length is usually an inch and a half. Their branches are few and small, viz. to the ureter, psoas muscles, glands, &c. The iliacs become increasingly tortuous with age : a point of importance in tying the vessel on an aged corpse.

Line. One drawn from a point an inch and a half below and a little to the left of the umbilicus to the centre of Poupart's ligament, the line curving a little outwards, will represent the course of the artery with sufficient accuracy.

Guide. The above line is the only surface guide : more deeply the lumbo-sacral articulation and the psoas muscles are useful guides, especially in a thin subject.[2]

Relations :

                        In Front
            Peritoneum ; small intestine ; cæcum and
                appendix, sometimes.
            Ureter.
            Sympathetic.

Outside	Right common iliac artery.	*Inside*
Psoas.		Left common iliac vein.
Vena cava.		
Right common iliac vein.		

                        Behind
            Right and left common iliac veins.

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[1] *St. Bartholomew's Hospital Reports*, vol. viii, p. 120.
[2] Attention has been drawn to the need of employing touch, as well as sight, in the ligature of these large trunks (p. 896).

In Front
Peritoneum ; small intestine.
Sympathetic.
Ureter.
Superior hæmorrhoidal artery.

Outside
Psoas.

Left common
iliac artery.

Behind
Left common iliac vein.

Collateral Circulation. The chief vessels are :

Above		*Below*
Internal mammary and lower intercostals	with	Deep epigastric.
Lumbar	,,	Ilio-lumbar and circumflex iliac.
Middle sacral	,,	Lateral sacral.
Superior hæmorrhoidal	,,	Inferior and middle hæmorrhoidal.

In addition, the pubic arteries anastomose behind the symphysis.

Operations (Figs. 386 and 387). The common iliac may be exposed either extra or transperitoneally. Of these the extraperitoneal route is the best. A posterior abdominal, or loin incision, by which the vessel is reached from behind ; a method made use of by Sir P. Crampton, of Dublin, in 1828, and by Mr. Stanley, at St. Bartholomew's, in 1846, does not afford such direct access. Moreover it damages the muscles and nerves of the abdominal wall too much. The same objections apply to anterior incision of Mott. The peritoneum is separated from the flank and iliac fossa, and displaced well in by broad retractors. The Trendelenberg position improves the view. The psoas muscle is felt and seen. On the inner side of this muscle the artery will be found, the external iliac being traced up if needful. In order to aid the surgeon in the difficulties which are now met with, owing to the artery lying at the bottom of a very deep wound, the abdominal walls should be relaxed by bending up the thighs, the wound sponged thoroughly dry, and light thrown in by a reflector or head lamp. The position of the vessel having been made out, it is defined with a blunt dissector, especial care being taken on the right side, as here both the common iliac veins lie behind the artery. The needle should be passed from within outwards, the ureter being drawn inwards and avoided.

LIGATURE OF THE INTERNAL ILIAC (Fig. 387)

Indications. Very few and rare.

(i) In some cases of gluteal and sciatic aneurysms. Mr. Holmes, in the course of those lectures from which I have already quoted, lays down conclusions which will very greatly help the surgeon in deciding what form of treatment is best suited to these aneurysms. They are quoted under the heading of "Ligature of the Gluteal Artery" (vol. i, p. 835).

(ii) Hæmorrhage. This is most frequently met with in military surgery after gunshot wounds of the vessel itself, but more often of one

or more of its branches within the pelvis, the ball entering usually from the front through the inguinal region or behind through the sacrum.

Four such cases are given by Dr. Otis,[1] all being fatal. Two cases, in which this artery was tied for wounds of the sciatic and gluteal respectively, are given by the above writer (p. 332) ; both were fatal from hæmorrhage.

Dr. Liddell,[2] who, as U.S.A. Medical Inspector, saw much of military surgery, gives the following advice in cases of punctured wounds of this artery or its branches : " The wound should be explored by introducing the finger into it for the purpose of locating by touch the precise point whence the blood issues by jets into the wound. If the punctured artery is found to be external to the pelvis, the bleeding-point should be laid bare by enlarging and cleansing the wound, and the vessel secured by ligatures placed on each side of the aperture. But if it be shown by the occurrence of intrapelvic extravasation of blood, or by other signs, that the internal iliac artery, or some branch thereof, is wounded within the pelvis, it will be impossible to reach and tie the punctured artery in the wound. Under these circumstances it sometimes becomes very difficult to decide what plan of treatment should be adopted. The first thing to be tried, in most cases, is compression. It should be applied to the common iliac artery, and, at the same time, to the wound itself, if possible, with a view to obtain coagulation of the blood in, and obliteration of, the wounded artery. The very desperateness of these cases makes it all the more necessary to use the compression faithfully, intelligently, and persistently, otherwise a traumatic aneurysm will form." Nowadays laparotomy will very likely be resorted to (p. 903).

(iii) To bring about atrophy of the enlarged senile prostate.

Dr. Bier was the first to tie the internal iliacs for the above purpose.[3]

He did this in three cases, in one intra peritoneally and in two extra peritoneally. In the first case the way in which the anæsthetic was taken caused so much trouble that, Trendelenberg's position failing, it was found needful to withdraw a large part of the small intestine, in order to reach the arteries. This patient died of septic peritonitis on the third day.

The two cases in which Dr. Bier operated by the extra peritoneal method recovered. Neither, before the operation, had been able to pass a drop of urine. Spontaneous power returned in each case, and improved progressively, one of the patients stating, four months later, that he could micturate as well as ever before.

Enucleation of the prostate is far easier, safer, and more certain.

(iv) In some cases of vascular pelvic sarcoma, and inoperable uterine tumours.[4]

(v) Also as a prophylactic against hæmorrhage in the course of certain pelvic operations, such as abdominal panhysterectomy, and in abdomino-perineal excision of the cancerous rectum.[5]

Surgical Anatomy. A short trunk, about an inch and a half long, of large size, the internal iliac, given off opposite to the lumbo-sacral intervertebral disc, dips downwards and backwards as far as the upper part of the sacro-sciatic notch, where it gives off its anterior and posterior trunks, a ligamentous cord also coming off from the bifurcation. This cord, the remains of the obliterated hypogastric artery, usually remains pervious as far as the bladder, as one of the vesical arteries.

[1] *Med. and Surg. History of the War of the Rebellion*, pt. ii, p. 331.
[2] *Intern. Encycl. of Surg.*, vol. iii, p. 125.
[3] *Wien. Klin. Woch.*, No. 32, August 10, 1893.
[4] Baudet and Kendirdjy, *Gaz. des Hôpitaux*, April 1, 1899.
[5] *Ibid.*

Line. No distinct line or guard can be given for this vessel owing to its at once dipping into the pelvis, but it will be worth while to remember that a line drawn with a slight curve outwards from a point about an inch below and a little to the left of the umbilicus, to the centre of Poupart's ligament, gives sufficiently accurately the line of the common and external iliac arteries ; the internal is given off about two inches from the commencement of this line.[1]

Relations :

<div align="center">

In Front

Ureter.
Peritoneum.
Rectum (left side).

</div>

Outside	*Inside*
Right internal iliac vein.	Pyriformis.
Obturator nerve.	Sacral nerves.

<div align="center">

Internal iliac.

Behind

Internal iliac vein.
Sacro-iliac synchondrosis.
Lumbo-sacral cord.

</div>

Collateral Circulation :

Sciatic	with	Superior branches of profunda.
Hæmorrhoidal branches	,,	Inferior mesenteric.
Pubic branch of obturator	,,	Vessel of opposite side.
Branches of pudic	,,	Branches of opposite vessel.
Circumflex and perforating of profunda	,,	Sciatic and gluteal.
Lateral sacral	,,	Middle sacral.
Circumflex iliac	,,	Ilio-lumbar and gluteal.

Operation. An incision five inches long is made vertically over the outer and lower third of the rectus, and this muscle is displaced inwards. The posterior wall of the rectus sheath and the thin transversalis fascia are very carefully divided. The peritoneum having been displaced inwards and upwards, the hips are well flexed, and the lips of the wound retracted as widely as possible. The finger now finds the external iliac, and then, by tracing it up, the internal iliac vessel.[2] The cord-like obturator nerve must not be mistaken for this. The Trendelenberg position is adopted and improves the view.

The artery is now separated, partly with the finger and partly with the point of the director, and the needle passed from within outwards, avoiding the vein and psoas muscle. The ureter usually crosses the artery at its commencement, and will be out of harm's way. It will be well to have in readiness aneurysm-needles of different curves, and an ordinary silver eyed-probe.

Ligature of the Internal and other Iliacs by Abdominal Section. This method has been advocated by Dr. Dennis,[3] of New York, for the

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[1] The origin of the arteries will be found nearly opposite to the centre of a line drawn from the anterior superior spine to the umbilicus.

[2] The finger should be passed downwards and backwards towards the sacro-iliac synchondrosis.

[3] *New York Med. News,* November 20, 1866 ; *Annals of Surgery,* vol. v, No. 1, p. 55. I am indebted to the latter periodical for the above account.

following reasons : (1) Abdominal section in no way increases the dangers of the operation of ligature of the internal iliac. (2) This method prevents a series of accidents which have occurred during the performance of the operation of ligature of this artery by the older methods. Amongst these are, the division of the circumflex and epigastric arteries, wounding the vas deferens, including the ureter in the ligature, puncturing the iliac or circumflex veins, tying the genital branch of the genito-crural, tearing the peritoneum, injury to the sub-peritoneal connective tissue, cellulitis. (3) Abdominal section enables the surgeon to apply the ligature at a point of election, and to obtain information as to the exact extent of the disease in the main arterial trunk. (4) Securing the internal iliac by this method takes much less time than was occupied by the older ones. The free extraperitoneal incision advised above avoids these dangers.

Three cases are given by Dr. Dennis, two of which occurred in his own practice :

(1) A woman, aged 60, presented pulsatile tumours in both gluteal regions, the tumours dating back a year and a half, and pain three years back. The external parts being thoroughly purified, a median incision was made from the umbilicus to the pubes ; the small intestines, which would have hindered the operation, were drawn out into warm moist sponges and towels, the internal iliacs of both sides ligatured with catgut, the viscera returned, the wound closed, and aseptic dressings applied. The patient died, with suppression of urine and slight parenchymatous nephritis, on the third day. (2) A negro, aged 46, had a right gluteal aneurysm, the trouble dating back seven months. By a curved lateral incision the abdomen was opened ; owing to the violent efforts of the patient, and the difficulty of mani-pulation, a few coils of intestine were drawn out, a strong silk ligature applied to the internal iliac, the parts cleansed, and the wound closed. A cure followed. (3) A female, aged 18, had an aneurysmal varix of the left side, the trouble dating back many years. Under careful antiseptic treatment the abdomen was opened, the incision finally extending from the symphysis to some distance above the umbilicus, the intestines drawn out sufficiently to admit of exposure of the vessel, a double twisted catgut ligature applied to the left internal iliac, the bowels returned, and the wound treated as before. The patient rallied quickly, and the bowels were moved normally on the fifth day ; a slight acute albuminuria, due to congestion of the kidney from the ligature of the main trunk of the internal iliac, appeared on the following day, but soon disappeared. The aneurysm, together with the aneurysmal varix, was perfectly cured.

A few cases in which the iliac arteries have been tied intraperi-toneally in this country are on record. One of the most interesting of these is fully recorded by Mr. Makins.[1]

The patient, aged 30, had an inguinal aneurysm, about two inches in breadth, extending upwards about two-fifths of the distance between the middle of Poupart's ligament and the umbilicus, and for about two inches below the ligament. An incision four inches long was made in the left linea semilunaris ; the deep epigastric, which originated in the swelling, was tied between two ligatures. The small intes-tines were held over to the right with Messrs. Ballance and Edmunds' broad abdominal retractor ; the sigmoid flexure was pushed upwards, and an incision made through the lower part of its mesentery and the peritoneum at the margin of the pelvis in the course of the external iliac. The wound was deep, there being about an inch and a half of subcutaneous fat, and abundance of fat in the sub-peritoneal tissue, both beneath the anterior abdominal wall and around the vessel. This, together with some retching, rendered the freeing of the artery and the passage of the ligature a process of some difficulty. The spermatic vessels were also exposed and swelled up considerably in the wound. The artery was secured about three-quarters of an inch below the bifurcation of the common iliac, and an inch and a half above the sac. Two threads of stout flossy sterilised silk were tied separately,

[1] *Lancet*, 1892, vol. ii, p. 1328.

but in close apposition, and with sufficient firmness to rupture the internal and middle coats. The posterior peritoneum was sutured over the artery. The patient left the hospital, with the aneurysm hard, painless, and shrinking, on the forty-seventh day.

The following remarks from Mr. Makins, well known not only as a surgeon but also as an anatomist, I quote *verbatim :*

" The reason for selection of the intraperitoneal method in this case was the high position of the aneurysm. Before operation the pulsation in the iliac fossa was so forcible and extensive that it seemed probable that it might prove necessary to ligature the common iliac, and it was thought that this would be more readily performed by the intraperitoneal method. Beyond this the intraperitoneal method seemed to offer the great advantage of not in the least interfering with the coverings of the sac, which, by the ordinary method, might have been disturbed by the stripping of the peritoneum. The experience gained by the operation showed that the usual method might have been safely adopted, but this could not be definitely determined beforehand. An advantage was gained in ready access to the deep epigastric artery, which, as directly feeding the sac itself, needed ligature, but, of course, might readily have been secured by an extension of the ordinary wound. As to the comparative difficulty of the two operations I think there is little to choose, and on the whole the incision for the extraperitoneal method is perhaps to be preferred in the matter of cicatrix ; in the vertical incision the advantage of suturing the fibrous structures in the linea semilunaris is gained ; but, on the other hand, the resulting cicatrix passes directly through from skin to peritoneum. In the oblique incision the decussation of the various muscular layers leads to a certain intricacy and irregularity in the line of the cicatrix which may render it the stronger, since pressure is less readily brought to bear directly upon it. The choice of the iliac vessels obtained is, I think, a real advantage, since the incision needs neither extension nor modification ; but in saying this it should be pointed out that this is a much stronger argument on the right than on the left side of the body. Ligature of the right common iliac artery by the intraperitoneal method is probably the easiest of all the operations on the great arteries, since the vessel lies directly beneath the peritoneum of the posterior abdominal wall, uncovered by any structure of importance. On the left side, on the other hand, the inferior mesenteric vessels as they enter the sigmoid mesocolon, and pass down to the mesorectum, cover practically the whole of the artery, and to reach the common iliac comfortably and safely the peritoneum would need to be divided close to the left of the median line of the sacrum and displaced outwards. This manoeuvre has the disadvantage of exposing the vein freely, but this would probably give far less trouble than the numerous mesenteric vessels would when swollen by reason of the loss of their peritoneal support. In the case recorded above the distension of the spermatic vessels, when set free by the division of the peritoneum, was much greater than would have been expected."

This most instructive case possesses the additional and especial interest that the patient developed a similar aneurysm on the right side a few months later.[1]

On May 3, 1893, Mr. Makins tied the right external iliac intraperitoneally An incision, commencing an inch below the level of the umbilicus and four inches long, was made in the right linea semilunaris. The abdomen being opened, the small intestine was packed away with two small sponges, and the posterior wall exposed. The artery was then seen below the termination of the ileum, crossed by the spermatic vessels. The aneurysmal sac was about an inch and a half in diameter. The peritoneum over the artery being divided, the vessel was ligatured with two strands of floss silk, tied with separate reef-knots, and then the peritoneum sutured over the artery. The patient was kept in bed for two weeks, and went out on the thirty-eighth day, having made an excellent recovery. A firm linear scar was present in the left linea semilunaris, and two small, hard swellings marked the site of the cured aneurysms. Mr. Makins stated that he repeated the transperitoneal method here, because the first had proved so successful, and because the aneurysm, though small, was situated entirely above Poupart's ligament. The operation on the right side proved much easier than that on the left, since the crossing of the ileum was on

[1] *Lancet,* 1893, vol. ii, p. 196.

a higher level than was the case with the sigmoid mesocolon. The artery also was far more prominent on the brim of the pelvis. The circulation was re-established much more rapidly and satisfactorily after the second than after the first operation. On the first occasion the limb was very cold, and the patient suffered much neuralgic pain ; on the second the local temperature fell little, if at all, and the patient had no pain. On the first occasion the deep epigastric was tied, a step not taken on the second, but Mr. Makins was inclined to think that the rapid re-establishment of the circulation was rather dependent on the enlargement of the branches of the internal iliac on the opposite side resulting from the obstruction of the first external iliac artery.

The two following cases, in which abdominal section was resorted to for ligature of the external iliac, show a striking contrast in the difficulties which may be met with :

In Sir Mitchell-Banks' case,[1] the patient, aged 62, had an ilio-femoral aneurysm as big as a fist occupying the upper part of the right Scarpa's triangle, pushing its way up beneath Poupart's ligament. On September 20, 1892, the abdominal cavity was opened by an incision about three inches long in the right linea semi-lunaris. The cæcum and small intestines which came into view were held apart by the hands of an assistant. The position of the external iliac being readily detected, the artery was tied with catgut, and sufficient pressure used to stop the pulsation in the aneurysm, and no more, no attempt being made to divide the internal coat. The incision in the peritoneum immediately over the artery was stitched up with fine catgut, so as to make the artery and ligature once more extra-peritoneal. The patient's recovery was uninterruptedly successful, save for one incident. On the eleventh day the sudden onset of acute præcordial pain and cyanosis, dyspnœa, and collapse was thought to point to detachment of some bit of clot from the neighbourhood of the ligature. These complications gradually disappeared. For some time the aneurysm contained fluid at one part, but gradually contracted, and the patient went out on the forty-second day after the operation. Sir Mitchell-Banks made use of the abdominal section here because the aneurysm pushed well up beneath Poupart's ligament, and he could not make out with certainty what was the condition of the artery above it.

The second case, under the care of Mr. W. H. Brown, of Leeds, tells a very different story of the difficulties which may attend ligature of the external iliac by abdominal section. In all these cases the high Trendelenberg position is of the greatest assistance.

The patient, a woman, aged 48, was admitted into the Leeds General Infirmary with two femoral aneurysms. The upper one, the size of a large cocoa-nut, occupied the right groin, extending upwards above Poupart's ligament ; the second, a smaller one, occupied the middle third of the same right femoral vessel. The skin over the upper swelling was dark, very thin, and threatening to give way. The position of the upper aneurysm was thought to preclude any of the usual operations, and it was decided to tie the external iliac intraperitoneally, by a median incision. The abdomen was opened by an incision at first four and later six inches long, owing to the great amount of fat in the abdominal wall. The omentum was also very thick, and greatly embarrassed manipulation. It was only after the pelvis had been well raised and emptied of the small intestines that a view could be obtained of the vessel. Mr. Brown states that he had the greatest difficulty in obtaining, first of all, a view of the vessel ; secondly, in passing the ligature. So far as the abdominal conditions were concerned the patient made a good recovery, but, the foot and leg becoming gangrenous, amputation of the thigh became necessary. The patient sank about ten weeks after the ligature of the artery.

Mr. Wherry[2] made use of the intraperitoneal method for ligature of the left internal iliac in a case of large pulsating sarcoma of the upper, outer, and back parts of the innominate bone. The swelling was too large and vascular to admit of its removal safely.

" An incision was made from below the umbilicus to the pubes. There were two difficulties. Firstly, the vein, which was very large and much in the way, was

[1] *Brit. Med. Journ.*, 1892, vol. ii, p. 1163.　　　　[2] *Lancet*, 1893, vol. ii., p. 136.

swollen by the slightest pressure of sponges or retractors upon the upper part. The external or common iliac would have been much easier to tie in this case. There was some venous bleeding, which stopped after the artery was tied, but the vein also was tied by a ligature just below the first one to make it safe. The other difficulty was with the light. Large reflecting refractors were of the greatest use, but an electric light would have been better still." The patient made a good recovery. The swelling at once shrunk and ceased to pulsate, and the relief to pain and other distressing symptoms was very great, but no further result is given.

Sir Frederick Treves [1] made use of this method in a boy, aged 16, with a vascular tumour of the buttock, in November 1889. He employed an incision from the umbilicus to the pubes, and kept the intestines packed up and aside with six sponges.

The following is Sir Frederick Treves' opinion of the merits of the operation,[2] and he is inclined to extend this method to the common iliac also : " The advantages of this method are obvious. The vessel is easily and fully exposed, and the needle can be passed without risk to the vein or ureter. The operation is simple, and involves but little time. Its dangers are, comparatively speaking, very few. The ligature can be applied accurately at the spot determined upon. The condition of the artery and the surrounding parts can be made out, and a diagnosis confirmed or modified. The great objection that some few years ago would have been urged against the procedure—the risk of acute peritonitis —may be at the present day almost disregarded."

Writing as I do for those whose operative experience is not to be compared with that of Sir Frederick Treves, I hesitate to endorse the above opinion in its entirety. I am of opinion that with the above incision the intestines will sometimes give great trouble. Mr. Maynard,[3] in tying the right common iliac artery for a diffusing aneurysm of the external iliac, had much trouble with the small intestines, the whole of which had to be drawn out of the abdomen and wrapped in warm sterilised towels. The operation then became perfectly simple. Mr. Maynard did not have the advantages of the Trendelenberg position, and of broad and deep retractors, both of which are invaluable. The patient died on the seventh day, the cause of death remaining uncertain, for no autopsy was allowed. Mr. Currie [4] records a successful case of transperitoneal ligation of the left external iliac for aneurysm of its lower part. A median incision was used, and the artery was easily tied with the aid of the Trendelenberg position and good retractors. A good deal of handling and exposure will be inevitable, and we all know that where the above are entailed under unfavourable circumstances, as in warfare, septic peritonitis may develop. Under favourable circumstances, with modern skill in abdominal surgery, and the advantage of the Trendelenberg position, good intestinal retractors, and reflected light, it is certain that the transperitoneal approach will become more and more popular for the reasons so clearly indicated by Sir Frederick Treves and Mr. Makins (p. 904). This route is particularly suitable for ligation of the internal and common iliacs, and for cases of aneurysm of the external iliac when it is not certain beforehand that a ligature can be safely applied to this vessel extraperitoneally. In these a peritoneal incision enables the surgeon to decide whether a ligature can be placed on the external iliac or must be applied to the common iliac— a much more risky procedure as regards gangrene of the foot and leg. In

[1] *Operative Surgery*, vol. i. p. 213.   [2] *Loc. supra cit.*, p. 211.
[3] *Ind. Med. Gazette*, vol. xxxviii, No. 7, July 1903.
[4] *Ann. of Surg.*, vol. iv, 1905, p. 620.

gunshot injuries or stabs, the intraperitoneal method will, of course, be made use of so that the abdomen can be explored.   My readers should refer to Mr. Makins' opinion on the intraperitoneal method, quoted at p. 905.

The high Trendelenberg position and the use of large gauze pads to keep the small intestine out of the way greatly facilitate the operation.

LIGATURE OF THE ABDOMINAL AORTA

Indications.   As this most rare operation has been fatal in every case its justifiability has naturally been called in question.   On the one hand, the desperate condition of the patients, the advanced amount of disease probably present in their arteries, hearts, &c., the large and rapid blood-current, the disturbance of very vital parts, and the risk of paralysis, all combine to render the probability of success extremely small.   On the other hand, recent improvements in surgery, the introduction of better igatures, the fact that in these cases life must speedily end if nothing be done, and, perhaps, the fact that many of the major operations of surgery have been unsuccessful at first, will justify surgeons in again making trial of this forlorn hope, if they feel certain that otherwise the case is quite hopeless.   Since R. T. Morris [1] has been able to demonstrate the possibility of making an aortic aneurysm " fill with clots by the application of a temporary ligature to the aorta, and that circulation in the extremities can be re-established on the removal of the ligature," some hope may be entertained of obtaining a success by a modification of his method.

The cases have mostly been those of iliac and inguinal aneurysm in which other arteries have been tied without success.   To justify the epithet above given of " desperate," the first case, the well-known one of Sir A. Cooper (in 1817), [2] may be alluded to.

Here the patient had long suffered from an aneurysm affecting the external and common iliac arteries, leading to sloughing of the skin and hæmorrhage.   Sir Astley having failed in an attempt to perform the old operation, owing to the artery lying so deeply, gave the patient " the only hope of safety " which remained by tying the aorta.

As life was here prolonged for forty hours, and as in Monteiro's case death did not take place till the tenth day, proof is given of the restoration of the collateral circulation.[3]

In addition to the above cases in which the aorta has been tied in cases of aneurysm, it has been tied once for hæmorrhage after a gunshot injury of the upper part of the thigh, by Czerny, of Heidelberg.   Hæmorrhage continuing, the common femoral was tied, together with the superficial femoral below the profunda.   Bleeding taking place again in six days, the common iliac was tied.   The hæmorrhage still persisting, it was thought that the external iliac only had been tied, and a ligature was next placed, by mistake, upon the aorta.   The patient lived twenty-six

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[1] *Loc. infra cit.*
[2] *Prin. ard Pract. of Surg.* (edited by Dr. Lee), vol. i, p. 228.
[3] In comparing instances of the restoration of the circulation, the one by disease and the other after the surgeon's ligature, the importance of the slow and gradual process in the one case will not be lost sight of.   Mr. Barwell (*Intern. Encycl. of Surg.*, vol. iii, p. 481) alludes to the experiments of Pirogoff (Waller and von Gräfe's *Journ.*, Bd. xxvii, S. 122) and a paper by Kast (*Zeit. f. Chir.*, Bd. xii, S. 405) to show that the collateral circulation is established.   Sir A. Cooper (*loc. supra cit.*) used to show in his lectures an injected specimen from a dog which survived the operation.   Beyond this fact, however, no comparison can be made between the chance of survival of healthy animals and that of patients reduced to such straits as to call for this operation.

hours. The same surgeon during a nephrectomy for a soft malignant growth of the kidney met with such uncontrollable hæmorrhage as to compel him to tie the aorta, the patient dying soon after.

Surgical Anatomy. The lowest part of the aorta, viz. that between the bifurcation and the origin of the inferior mesenteric, is that which should be chosen.[1]

The vessel may have in front of it the omentum, duodenum, mesentery, small intestines, and more closely the aortic plexus of the sympathetic, and a layer of fascia of various strength. To the right side lies the vena cava, and behind it are the left lumbar veins. The bifurcation is usually situated a little to the left side of the umbilicus and about three-quarters of an inch below it.

Operation. This may be performed (A) through, or (B) behind, the peritoneum. The intraperitoneal method is especially indicated when the height at which the ligature must be applied, or any evidence of matting of the structures of the abdominal wall (dating to inflammation about the aneurysm, or to the use of pressure), would probably interfere with stripping up the peritoneum.

A. *Through the Peritoneum.* The high Trendelenberg position is adopted, and an incision five inches long, with its centre opposite the navel, is made through the inner fibres of the left rectus. The intestines are packed up out of the way and the peritoneum over the lower part of the aorta is picked up and incised. Care should be taken to disturb as little as possible the aortic plexus[2] during this step and in passing the needle, which should be carried from right to left.

The ligature used should be one of the flat tape-like ones, of kangaroo tendon or sufficiently stout silk. The passage of the needle may be attended with much difficulty,[3] not only from the depth of the vessel, and from the presence of intestines if distended and allowed to protrude into the wound, but also from the density of the cellular tissue surrounding the artery.

B. *Behind the Peritoneum.* This method should be tried in any case where the surgeon is unable to take those precautions for which intraperitoneal surgery calls. The chief objection is the great depth at which the artery is reached ; but it is well worthy of notice that in Monteiro's case, which survived ten days, this method was made use of.

The operation is performed on much the same lines as that already given for ligature of the common iliac (p. 901). The incision should be free. The muscles and transversalis fascia being cut through, the peritoneum is stripped up and turned inwards, several large retractors placed in the wound, and the ribs dragged up and outwards. The common iliac being found, this vessel is traced up into the aorta.

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[1] This interval varies in length from half an inch to two inches.

[2] Sir A. Cooper (*loc. supra cit.*) believed that his experiments on dogs proved that inclusion of this plexus, and not the interruption of the circulation, was the cause of the paralysis which followed the experiment. In Mr. James's case, when the ligature was tightened, the patient complained of " deadness in the lower extremities." This was soon followed by agonising pain in the same parts, only relieved by death about three hours after the operation.

[3] Thus, in Mr. James's case the aneurysm-needle broke at its handle, the surgeon having " little anticipated occasion for so much force." In one case the sac gave way during the operation.

THE SURGICAL TREATMENT OF ABDOMINAL ANEURYSM

(A) **Aneurysm of the Abdominal Aorta.** In spite of recent advances in treatment, the prognosis of this disease remains extremely grave. The late Mr. J. H. Bryant[1] found that the average duration of life in these cases is about thirteen months from the time that the aneurysm first becomes manifest. He pointed out that the condition was correctly diagnosed during life in only eighteen of his fifty-four cases, and also that the opposite mistake of diagnosing an abdominal aneurysm which is not present is even more frequent; 67 per cent. of the cases occur in the neighbourhood of the cœliac axis.

A few cases of spontaneous recovery are on record, and Osler[2] has "seen at least two instances of spontaneous healing in aneurysm of the abdominal aorta." Very little is to be hoped for from medical treatment.

Osler[3] has never seen a case cured by medical treatment. The Tufnell diet and large doses of iodide of potassium are disappointing and unpleasant; the gelatine treatment is dangerous, and of but little permanent value.

Surgical procedures may prolong life in some cases, and shorten it in others (*vide infra*).

(1) **Compression above the sac** in the rare cases that it is possible to apply it may be successful, as in the case under Dr. Murray, of Newcastle; this patient remained well for six years. This treatment can rarely be employed owing to the high position of the great majority of aortic aneurysms (*vide supra*), and it is not free of danger, the intestines and other viscera being liable to serious injury from compression against the spine.

The latter objections apply equally to distal compression.

(2) **Acupuncture.** This method has been fully alluded to in vol. i; and a brilliantly successful case of abdominal aneurysm treated by Prof. Macewen with needles, and the formation of white thrombi, may be mentioned. This patient was at work for over two years and a half after the treatment.

The only safe method of applying this and the galvano-puncture treatment of Velpeau is after laparotomy, the overlying viscera may otherwise be injured.

(3) **Introduction of Wire** (Moore). This method has been described in vol. i. Prof. Loreta, of Bologna, has applied it to one case of abdominal aneurysm which attracted much attention at the time, but proved, as is so common in these cases, only temporarily successful. An account will be found,[4] taken from the original paper.[5]

The patient was a sailor, aged 30, who had always had good health, save for syphilis five years before. Nearly two years before his admission he had felt something give way in the belly while making violent efforts. A large aneurysm occupied the epigastric and left hypochondriac regions. An incision having been made from the ensiform cartilage to the umbilicus, numerous superficial adhesions were found, and carefully separated, but it was found impossible thus to deal with deeper ones uniting the sac to the stomach, spleen, and diaphragm. Hence it was impossible to trace the aneurysm to its mouth, nor could it be compressed and emptied. It

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[1] *Clinic. Journ.*, November 25, 1903.
[2] *Lancet*, October 14, 1905.   [3] *Ibid.*
[4] *Brit. Med. Journ.*, vol. i, 1885, pp. 745, 955.
[5] *Mem. Roy. Acad. Scien, Institute of Bologna*, February 8, 1885.

remained uncertain, therefore, at the time, whether the aorta or one of its branches was the vessel involved. The vessel, which was now fully exposed on its right side, was punctured with a fine trocar, and silvered copper wire passed in from above downwards and to the left. As soon as the wire met resistance the cannula was removed, the end of the wire pushed in, and the puncture brushed over with pure carbolic acid. A little over two yards had been introduced. The after-course was one of rapid and progressive recovery. The man was allowed to get up at the end of six weeks, the swelling having consolidated, the bruit having disappeared, the pulsation being only communicated, and the femoral pulse, which had been almost suppressed, having reappeared. The patient died suddenly, ninety-two days after the operation, from rupture of the aorta immediately below the sac at the angle of juncture between this and the aorta. The sac, filled with organising fibrin, had shrunk to the size of a walnut. The wire was found unaltered and rolled up in a globular mass. Prof. Loreta suggested that the compression produced by the coagula in the sac might have caused an interference with the blood-supply to the arterial wall just below the swelling, and so induced rupture of an artery no doubt already diseased.

D'Arcy Power and Colt [1] reported a case in which 80 inches of silver wire were introduced into an abdominal aneurysm through an ingenious but rather complicated instrument invented by Mr. Colt. Pulsation diminished but did not vanish. The patient died 50 hours after the operation. A loop of wire had passed into the aortic arch, but most of it was coiled up within the sac amongst recent clots which filled the sac. The whole operation lasted about half an hour, but the actual introduction of the wire only took two minutes and a half. The hole in the sac was easily closed with a few Lembert sutures.

The following advantages are claimed for the instrument: Quickness, kinking of the wire is avoided, and the risk of hæmorrhage is greatly diminished.

Maunsell [2] collected eight cases of abdominal aneurysm treated by Moore's method with three cures of the aneurysm. It is not stated how long these cases were observed. The cases that did best were those in which about five or six feet of wire were used.

(4) **The Moore-Corradi Method.** Corradi [3] introduced a modification of Moore's method; having passed seventeen inches of wire into a thoracic aneurysm, he then sent a galvanic current through the wire. The patient survived for thirteen weeks. Hunner [4] has collected twenty-three cases of thoracic and abdominal aneurysms treated by Corradi's method, with four cures, one improvement and prolongation of life, and " ten in which death was probably hastened."

Maunsell (*loc. cit.*) collected eight abdominal cases, including his own interesting case. One of these patients was cured.

Maunsell having exposed the aneurysm which was in the cœliac axis region, passed six yards of sterilised fine silver wire through a fine cannula. The patient improved for a time, but died from rupture of the aneurysm into the stomach on the forty-fifth day. Nearly all the aneurysm was filled with laminated and some recent ante-mortem clot, amongst which the wire was coiled; the wire did not project through the perforation.

Griffiths [5] records an interesting case in which he passed about six feet of wire into an aortic aneurysm placed just below the diaphragm. The patient died from shock after five hours and a half. The sac was filled with clot and wire coils. A double loop of the wire had passed into the thoracic aorta for two inches and a half. Much useful information and valuable practical hints are derived from the articles of Maunsell (*loc cit.*), Griffiths, and Stewart. [6]

The Operation. The aneurysm having been exposed through a laparotomy wound, and gauze packing employed to isolate a part of

[1] *Lancet,* September 19, 1903.   [2] *Brit. Med. Journ.,* June 18, 1904.
[3] *Lo Sperimentale,* April 1879, p. 445.
[4] *Bull. Johns Hopkins Hosp.,* November 1900.
[5] *Lancet,* August 12, 1905,   [6] *Phil. Med. Journ.,* November 12, 1898.

the presenting surface of the sac, a spot devoid of large blood-vessels is selected, and a purse-string suture is introduced to encircle a small area, through which a fine long trocar and cannula are thrust well into the sac (*see* Fig. 388, *A*, *B*). The trocar is withdrawn, and a vulcanite cannula (*C*) which fits the metal one accurately, is now introduced for insulating purposes. Sterile fine silver wire (No. 28)[1] is then introduced through the insulating cannula; if the wire kink it may be cut and driven into the sac by means of the ramrod (*D*) which has a cupped extremity. From three to six feet of wire are introduced according to the size of the aneurysm. Most operators have used too much wire. The wire is passed obliquely, so that its end may not pass straight into the aortic trunk, but may creep along the wall of the sac and coil within it. A current of 15–30 milliampere is passed through the wire for about fifteen minutes; 60–80 milliampere currents have been used, but these are apt to damage the sac wall, where the wire comes into contact with it, and moreover clotting is just as good with the weaker currents.
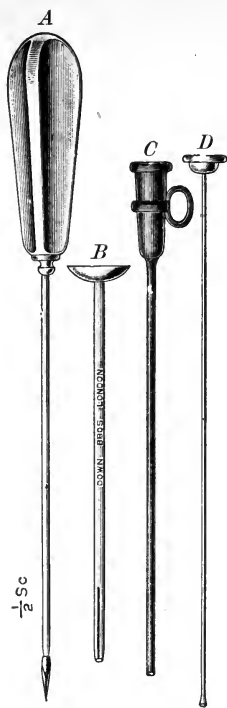
Stewart recommends that the anode should be connected to the wire, and the cathode to a clay plate connected to the patient's back or abdomen. Both poles must not be connected with the sac, and the cathode must not be attached to the wire, for gas is then evolved, and a soft clot formed, which is very different to the firm coagulum formed round the anode. The end of the wire is driven into the sac, and the purse-string suture tightened as the cannulæ are withdrawn. The wound in the abdominal wall is then sewn up in the usual way. Some of the dangers of the operation are shock, sepsis, circulatory disturbances arising from sudden increase of the blood pressure, rupture of the sac, or of the aorta near it; this is apt to occur when the aneurysm is shrinking after some day or weeks. Obstruction of the aorta from pressure of the clotted aneurysm, or projection of the wire into the artery; paralysis or even gangrene of the lower limbs may then occur, or interference with the aortic valves.[2] Such dangers as are inseparable from the general anæsthesia may be avoided in some cases by the use of eucaine and cocaine. The Moore-Corradi method is certainly worthy of further trial, and is the most hopeful method yet invented for the treatment of the majority of aneurysms of the abdominal aorta.

Fig. 388. *A*, Metal trocar; *B*, metal cannula; *C*, vulcanite cannula; *D*, ramrod. (Griffiths.)

(5) **Ligature of the Abdominal Aorta** (*see* p. 998). In only a few cases can a ligature be placed on the proximal side of the aneurysm (*vide*

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[1] Hunner (*loc. cit.*) prefers $\frac{75 \text{ copper}}{1000 \text{ silver}}$, which is finer and coils better than silver wire. Silver, gold or platinum may be used, but not hard iron or steel, as these snap or perforate the sac. Soft iron is decomposed too readily by the current and may lead to embolism. (Stewart, *loc. cit.*)

[2] Reeve, *Johns Hopkins Bull.*, November 1900.

supra, p. 908). Of the two recorded cases one died after one day and the other on the forty-eighth day.

(6) **Temporary Ligature of the Aorta.**—Milton[1] suggested that temporary proximal occlusion of the abdominal aorta might be attained by means of an elastic band, passed round the artery and spine backwards through the loins, where the ends could be tightened at will.

Prof. Keen,[2] who publishes a case of ligature of the abdominal aorta just below the diaphragm, the patient surviving forty-eight days, has devised an instrument by means of which temporary compression of the aorta may be carried out. The instrument, which is fully described and figured, consists of a screw clamp in two parts, which is applied directly to the aorta through an opening in the abdominal wall.

Four experiments on dogs are described, the results of which clearly show the feasibility of the plan.

Prof. Keen considers that the instrument might be used either for a short interval under anæsthesia, or might be left *in situ* for two or three days, during which pressure could be applied at intervals.

R. T. Morris[3] records a most interesting and suggesive case of temporary distal ligation of the abdominal aorta by means of a rubber catheter passed round the artery and kept taut by means of long clamp forceps. The elastic ligature was removed after twenty-seven hours, the aneurysm having filled with clot. Soon afterwards pulsation and sensation returned in the lower extremities. The patient, however, died on the third day from septicæmia, probably the result of gangrene of portions of the intestine which had been compressed by the steel clamp, but the patient also suffered from a previous pyonephrosis.

At the autopsy the aneurysm was found to be filled with clot, but the aortic lumen was patent. At the site of the elastic ligature the internal coat was not divided.

This case proves " that an aneurysm of the aorta can be made to fill with clots by the application of a temporary ligature to the aorta, and that the circulation in the extremities may re-establish on the removal of the ligature."

R. T. Stratton[4] records five experiments made upon dogs, and advocates the gradual closure of large arteries.

He used waxed cotton tape $\frac{1}{4}$ in. wide, which was passed round the aorta and through a gauze-covered silver tube, " both ends of the tape being fastened to the axle of a small windlass fixed to the instrument at its outer extremity. The revolving of this tightened or relaxed the tape at the will of the operator. The wheel could be fixed at any point by means of a hinged bar being pressed into small slots in the margin of the wheel." A circular perforated disk was attached to the arterial end of the silver tube, and the perforations for the tape were so arranged that the margins of the tape did not press unduly on and injure the pulsating artery. The pressure was gradually increased and occlusion completed after about 40 hours. No unfavourable symptoms due to the closure were observed. Stratton claims " that these experiments are sufficient to demonstrate the fact that at least in dogs a large artery can be gradually constricted without undue violence to its walls." Crile[5] had already proved that the carotid arteries could be *gently* occluded for 24–48 hours by clamp pressure without noticeable damage to the arterial wall, and that when the clamp was removed after a number of hours the circulation was re-established. Crile based his conclusions upon 19 experiments on dogs, and 18 operations on the human being. In no case did thrombosis or embolism occur.

[1] *Lancet*, 1891, vol. i, p. 85. 　　[2] *Amer. Journ. of Med. Sci.*, September 1900.
[3] *Ann. of Surg.*, February 1902. 　[4] *Ibid.*, 1903, vol. xxxviii, p. 256.
[5] *Ibid.*, April 1902.

Stratton believes that the gradual occlusion of the abdominal aorta above an aneurysm will be found very serviceable in the treatment of the latter ; he maintains that the best results are obtained by the gradual formation of laminated clot within the sac, and not by the sudden clotting of the contents *en masse*. Moreover, the collateral circulation to the abdominal viscera and limbs will thus have time to develop, and the serious symptoms that follow sudden complete occlusion of the aorta will be avoided. Further, it is possible that by this method the circulation through the aorta at the base of the aneurysm to the main arteries below may not be abolished.[1]

Stratton relates a case of aneurysm of the abdominal aorta treated in the manner described above.[2] The constrictor was applied above the sac and gradually tightened. The patient did well for two days, but then sensory and motor paralysis of the lower limbs developed, and death occurred.

The cause of death was the inhibition of the functions of the abdominal viscera, which resulted from the ultimate complete closure of the aorta above the cœliac axis. The sac was filled with stratified clot ; there was no injury or necrosis of the aorta.

This method is certainly worthy of further trial.

(B) **Aneurysm of the Iliac Arteries.** Proximal ligature is the best treatment for these, and the transperitoneal is the safest route to adopt, for this greatly reduces the risk of injuring the sac, and also allows a thorough examination of the vessels above the aneurysm. The ligature can then be applied at any spot selected, and without danger of including important structures like the ureter.

This operation, however, should not be lightly undertaken without the advantages of good assistance and modern conveniences, such as the Trendelenberg position and good intestinal retractors (*see* pp. 904 and 907, Mr. Makin's and Mr. Maynard's cases).

(C) **Aneurysm of the Hepatic Artery.** Kehr[3] records a successful case of ligature of the hepatic artery for an aneurysm of that artery which had simulated gall-stones at first and later ruptured into the cystic duct causing hæmatemesis.

Haussons, in 1897, collected twenty-two cases. In only three of these was surgical treatment attempted, and all the patients died.

Ligation or excision may be tried in a similar case, and also in the very rare cases of aneurysm of the splenic and mesenteric arteries.

(D) **Aneurysm of the Renal Artery.** Morris[4] was only able to collect the accounts of twenty-one cases of this rare condition, which is usually not diagnosed except during an exploratory operation for supposed ruptured kidney and perinephritic hæmatoma, a new growth, or hydro-nephrosis. Practically all the cases recorded have not pulsated, being diffuse. The only chance of saving life is by ligature of the renal artery, followed by nephrectomy and removal of the whole sac if possible.

An exploratory lumbar incision having been made, and the aneurysm discovered, the renal pedicle is secured either after stripping the peritoneum forward when the sac is small, or after opening the peritoneum through the linea semilunaris and incising the posterior peritoneum along the outer margin of the colon, which is drawn inwards.

The sac may be so adherent to the intestines or to the diaphragm that it cannot be safely removed in its entirety.

Only four cases have been treated by operation, and three of these recovered, whereas all the cases which were not treated surgically died.

[1] Morris, *supra cit.*　　　　[2] *Journ. Amer. Med. Assoc.*, March 10, 1906.
[3] *Munch. Med. Woch.*, 1903, p. 1861.　　[4] " Disease of the Kidneys and Ureters."

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